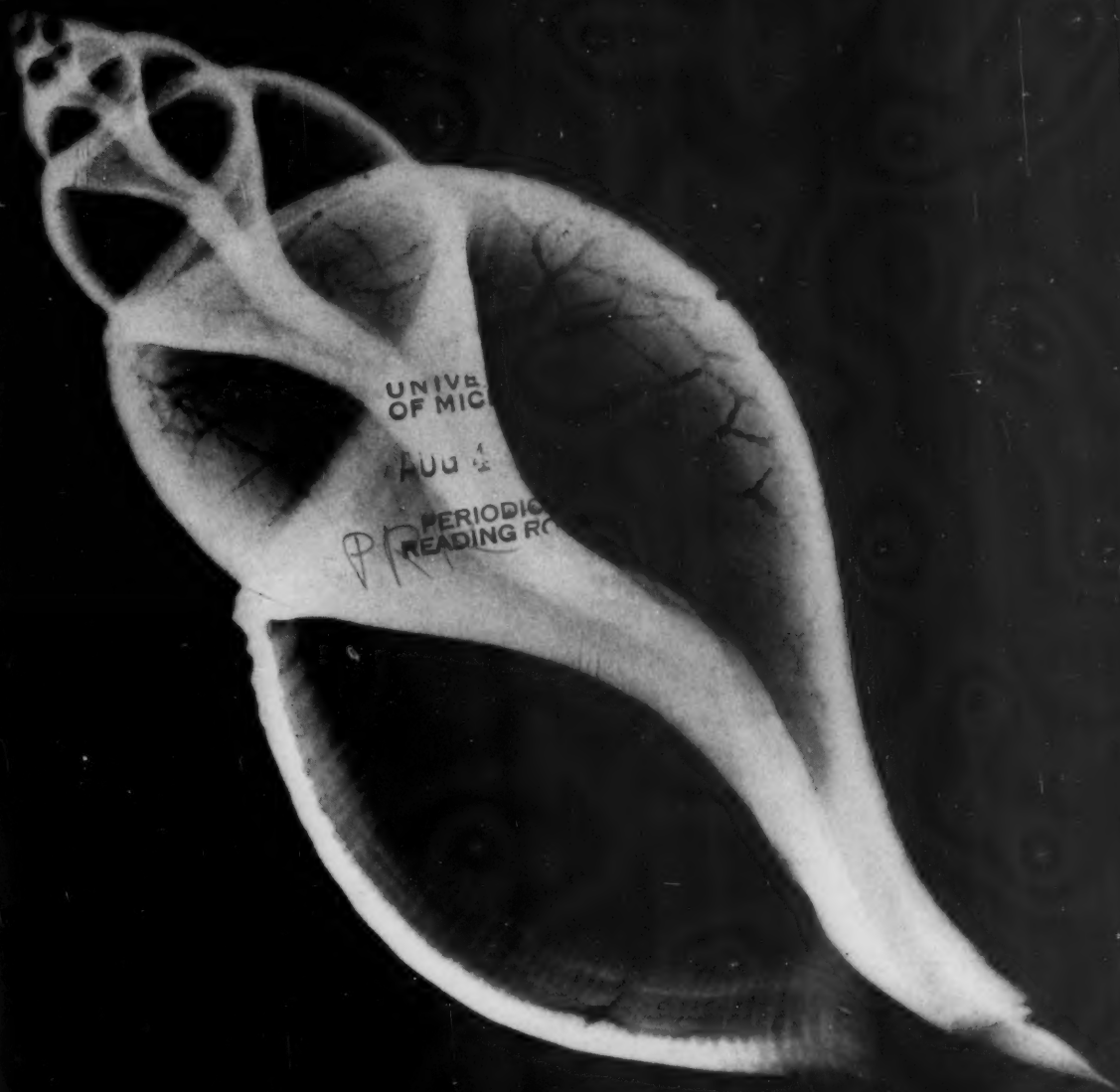


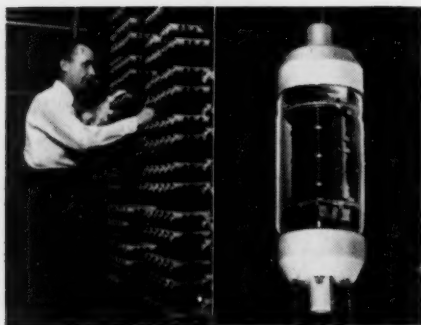
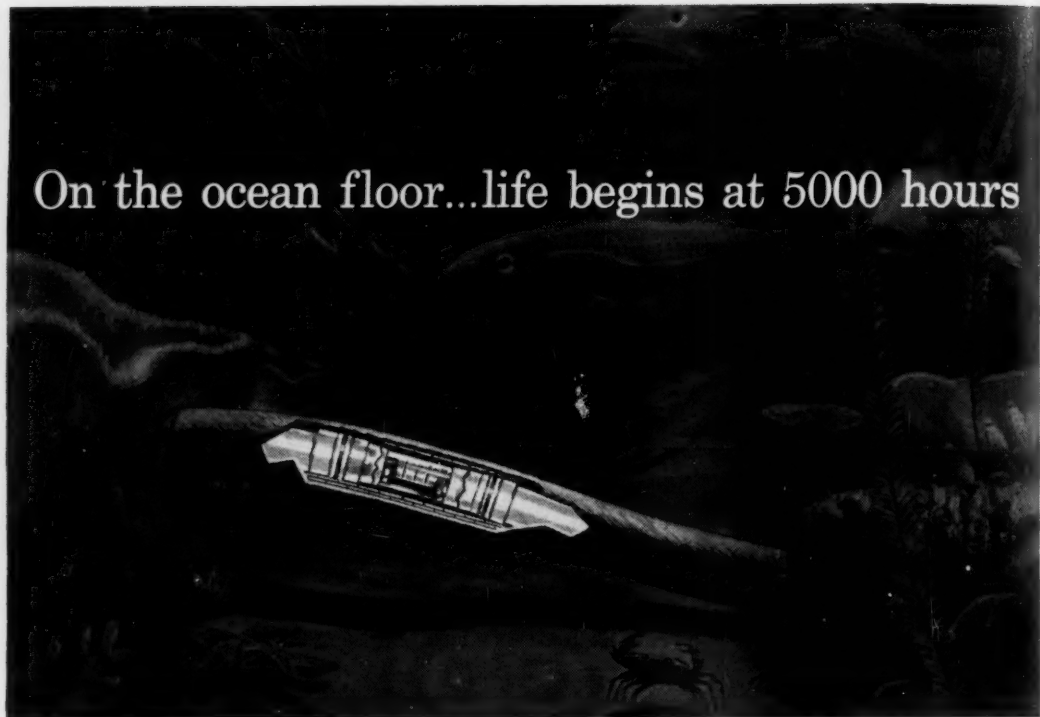
The
**SCIENTIFIC
MONTHLY**



AUGUST 1955

DL. 81 NO. 2

On the ocean floor...life begins at 5000 hours



Electron tubes (right) for the Transatlantic Telephone Cable between Newfoundland and the British Isles are being handmade at Bell Laboratories. Life test bank is shown left. The cable system, which can carry 36 simultaneous conversations, is a joint enterprise of the American Telephone and Telegraph Company, the British Post Office and the Canadian Overseas Telecommunications Corporation.

When the world's first transoceanic telephone cable is laid across the Atlantic it will contain hundreds of electron tubes needed to amplify voices. Deep on the ocean floor these tubes must keep working, year after year, beyond reach of ordinary repair services.

Bell Telephone Laboratories scientists have developed a tube of unique endurance. Before a tube is even considered for use in the cable it is operated for 5000 hours under full voltage—more than the entire life of many tubes.

But survival alone is not enough. During the test each tube is exhaustively studied for behavior that may foreshadow trouble years later. Tubes that show even a hint of weakness are discarded. For the good ones, a life of many years can be safely predicted.

Bell Telephone Laboratories scientists began their quest for this ocean-floor tube many years ago. Now it is ready—another example of the foresightedness in research that helps keep the Bell Telephone System the world's best.

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❧ Meetings ❧

August

- 1-5. American Oil Chemists' Soc., short course on analytical techniques, Urbana, Ill. (L. R. Hawkins, 35 E. Wacker Dr., Chicago 1, Ill.)
- 1-5. International Cong. of Plastic Surgery, Stockholm and Uppsala, Sweden. (J. F. Larsen, 12, Kristianiagade, Copenhagen, Denmark.)
- 1-6. International Cong. of Biochemistry, Brussels, Belgium. (C. Liebecq, 17 Place Delcour, Liège, Belgium.)
- 3-7. International Meeting of Neurobiologists, Groningen, Netherlands. (J. A. Kappers, Dept. of Anatomy and Embryology, Oostersingel 69, Groningen.)
- 5-6. Pennsylvania Acad. of Science, University Park, Pa. (K. Dearolf, Public Museum and Art Gallery, Reading, Pa.)
- 6-7. Linguistic Soc. of America, Washington, D.C. (A. A. Hill, 1719 Massachusetts Ave., NW, Washington, D.C.)
- 6-7. Minnesota Acad. of Science, Pipestone. (B. O. Krogstad, Science and Mathematics Div., Univ. of Minnesota, Duluth 5.)
- 8-10. Inst. of Aeronautical Sciences, Seattle, Wash. (S. P. Johnston, IAS, 2 E. 64 St., New York 21.)
- 8-13. International Council of Scientific Unions, Oslo, Norway. (Administrative Secretariat, ICSU, 29 Tavistock Sq., London, W.C.1, Eng.)
- 8-20. International Conf. on the Peaceful Uses of Atomic Energy, Geneva, Switzerland. (W. G. Whitman, Room 3468, United Nations, New York.)
- 12-17. Canadian Teachers' Federation, Ottawa. (G. G. Croskery, 444 MacLaren St., Ottawa, Ont.)
- 15-16. Operations Research Soc. of America, 7th national, Los Angeles, Calif. (R. A. Bailey, Military Operations Research Div., Lockheed Aircraft Corp., Burbank, Calif.)
- 15-18. American Veterinary Medical Assoc., Minneapolis, Minn. (J. G. Hardenbergh, 600 S. Michigan Ave., Chicago 5, Ill.)
- 15-19. American Inst. of Electrical Engineers, Pacific general, Butte, Mont. (N. S. Hibshem, AIEE, 33 W. 39 St., New York 18.)
- 15-19. American Soc. of Agronomy and the Soil Science Soc. of America, joint meeting, Davis, Calif. (L. G. Monthey, 2702 Monroe St., Madison 5, Wis.)
- 15-19. Plant Seminar, 32nd annual, Gainesville, Fla. (C. H. Johnson, School of Pharmacy, Univ. of Florida, Gainesville.)
- 15-20. International Dental Federation, 43rd annual, Copenhagen, Denmark. (W. R. Klausen, 1 Alhambravej, Copenhagen V.)
- 17-9. Canadian Mathematical Cong., 5th summer seminar, Winnipeg, Manitoba. (Secretariat, CMC, Chemistry Bldg., McGill Univ., Montreal.)
- 17-24. Australian and New Zealand Assoc. for the Advancement of Science, 31st, Melbourne. (J. R. A. McMillan, 157 Gloucester St., Sydney.)
- 19-28. International Conf. of Agricultural Economists, Helsingfors, Finland. (J. R. Currie, Dartington Hall, Totnes, Devonshire, England.)
- 19-30. North Central Conf. on Biology Teaching, Cheboygan, Mich. (R. L. Weaver, Box 2073, Ann Arbor, Mich.)

- 22-9. Wool Textile Research Conf., Sydney, Australia. (F. G. Nicholls, Commonwealth Scientific and Industrial Research Organization, 314 Albert St., East Melbourne, Australia.)
- 22-23. Electronics and Automatic Production Symposium, San Francisco, Calif. (W. D. McGuigan, Stanford Research Inst., Palo Alto, Calif.)
- 29-31. American Physical Soc., Mexico City, Mexico. (K. K. Darrow, Columbia Univ., New York 27.)
- 29-2. Infrared Spectroscopy Inst., 6th annual, Nashville, Tenn. (N. Fuson, ISI, Fisk Univ., Nashville 8.)
- 29-3. Mathematical Assoc. of America, Ann Arbor, Mich. (H. M. Gehman, Univ. of Buffalo, Buffalo 14, N.Y.)
- 29-5. International Astronomical Union, Dublin, Ireland. (P. T. Oosterhoff, IAU, Leiden Observatory, Leiden, Netherlands.)
- 29-6. International Horticultural Cong., 14th, The Hague, Netherlands. (G. de Bakker, International Committee for Horticulture, Bezuidenhoutseweg 30, The Hague.)
- 30-31. Soc. for Industrial and Applied Mathematics, 2nd general, Ann Arbor, Mich. (G. W. Preston, Research Div., Philco Corp., Philadelphia 34, Pa.)
- 30-2. American Mathematical Soc., 60th summer, Ann Arbor, Mich. (AMS, 80 Waterman St., Providence 6, R.I.)
- 30-3. Biological Photographic Assoc., Inc., 25th annual, Milwaukee, Wis. (L. C. Massopust, Sr., Marquette Univ. School of Medicine, 561 N. 15 St., Milwaukee 3.)
- 31-2. American Sociological Soc., Washington, D.C. (W. J. Warner, ASS, New York Univ., New York 3.)
- 31-6. International Assoc. for Hydraulic Research, 6th plenary, The Hague, Netherlands. (L. G. Straub, St. Anthony Falls Hydraulic Lab., Minneapolis 14.)
- 31-7. British Assoc. for the Advancement of Science, annual, Bristol, England. (BAAS, Burlington House, London, W.1.)

September

1. Assoc. for Symbolic Logic, Ann Arbor, Mich. (J. Barlaz, Rutgers Univ., New Brunswick, N.J.)
- 2-7. American Psychological Assoc., San Francisco, Calif. (F. H. Sanford, APA, 1333 16 St., NW, Washington 6.)
- 2-7. Psychometric Soc., San Francisco, Calif. (J. B. Carroll, Harvard Univ., 13 Kirkland St., Cambridge 38, Mass.)
- 2-9. International Cong. of Anthropological and Ethnological Sciences, 5th, Philadelphia, Pa. (A. Kidder, Univ. of Pennsylvania, Philadelphia, 4.)
- 3-7. International Council of Women Psychologists, San Francisco, Calif. (M. G. Reiman, Milwaukee County Guidance Clinic, Public Safety Bldg., Milwaukee 3, Wis.)
- 4-7. International Congress of Vitamin E, 3rd, Venice, Italy. (K. E. Mason, Dept. of Anatomy, Univ. of Rochester School of Medicine and Dentistry, 260 Crittenden Blvd., Rochester 20, N.Y.)

(Continued on page xii)

THE SCIENTIFIC MONTHLY

AUGUST 1955

What's Happening to Our Glaciers!

WILLIAM A. LONG

Mr. Long was trained in forestry and geology at the State College of Washington. He is presently working toward his M.S. degree in geology at Montana State University, Missoula. He has taught mathematics and science in the high schools of Washington and Idaho. In World War II, Mr. Long served with the 10th Mountain Division in Colorado, Italy, and Austria.

THE glaciers of Washington are perpetual, I thought, either stationary or advancing and always imparting a distinctive height and whiteness to the rugged hinterlands. Blinded by the dazzling icy covering, I developed a kind of mountaineer's indifference to the seemingly lasting beauty of the snowy peaks.

This was in 1937 when, as a boy living in the Wenatchee Valley, my mountain-climbing friends and I had much occasion to visit the rugged granite crags around Mount Stuart. This mountainous area, located about 40 mi west of Wenatchee, harbors several glaciers. Many times during these early years we visited the Snow Creek Glacier, the largest of the Stuart glaciers (Fig. 1). At first we failed to observe the melting, which had been in progress for several years. Melting prior to 1938 caused a large part of the front of the glacier to thin and collapse, with the result that spectacular icebergs were left floating in a small marginal lake. We saw these icebergs in 1938, but they had melted by 1940. As the melting continued, ice breaking from the ice front formed an ice cliff that increased in height (Fig. 2).

I was dismayed to observe that the glacier was rapidly shrinking. Perhaps other Cascade Mountain glaciers also were melting. I could imagine the peaks denuded of their icy covering, standing ragged and desolate, like rows of ancient saw teeth, all rusty and stained. My observations extended north of Mount Stuart to Lyman Glacier, in the

vicinity of Lake Chelan. The melting of this glacier was of almost catastrophic proportions.

What was happening to our glaciers? How long had they been melting? How large were they when first seen by the early-day observers? Is our climate getting warmer? These and other questions intrigued me, and I was determined to find the answers. The results are startling. After 15 years of study and firsthand observation, I find that one of the best indicators of the general trend of climates in the Cascade Mountain regions is the condition of the glaciers throughout these regions at any time.

How do glaciers reflect climatic changes? When the climates are cooled, precipitation generally increases, causing more snow to fall in mountainous regions where glaciers are found. If there is sufficient yearly holdover snow and ice, the existing glaciers reflect this increase by increasing in length and volume. Nowhere in the United States are the present-day glaciers as well developed as they are in the Olympic and north Cascade Mountains. Here the record of past climatic changes is clear and unmistakable, with the glaciers waxing and waning with broad uniformity, as the climate fluctuated from one extreme to the other.

A general recession of the Cascade Mountain glaciers has been in progress during the last few decades, setting in shortly after the middle of the 19th century. Published data indicate that not since the last great ice age, which ended more than

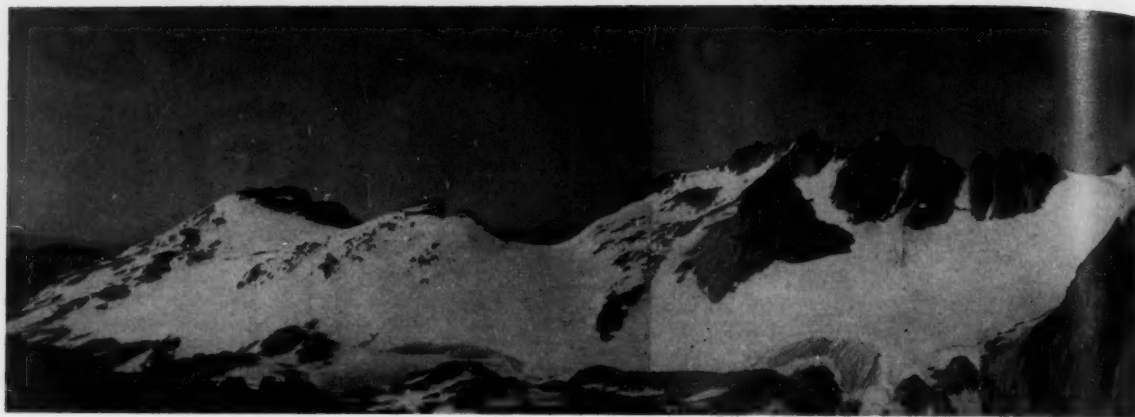


Fig. 1. Snow Creek Glacier in late June 1939, when the glacier still formed a continuous ice mass about 1 mi long. Melting thinned the glacier considerably, resulting in a few isolated patches of ice by 1948.

10,000 years ago, have the glaciers been more extensive than they were near the middle of the 18th and 19th centuries. This general recession, not significantly noticed until the early 1900's, did much to stimulate volunteer workers to gather field data on the variations in length and volume of the Cascade glaciers. They found that minor climatic fluctuations comprising two or three decades have temporarily halted the shrinkage, but apparently each fluctuation was of less duration than the former.

In order to picture better the chilly view of icy peaks greeting the eyes of the early observers, it is necessary to go back to the beginning of the 20th century near the height of the last glacier maximum. Soon thereafter the present great warming reduced many glaciers almost to insignificance. A veritable wilderness of icy peaks met the eyes of early 20th-century mountaineers who climbed the peaks for the thrill of conquest and to see what mystery lay beyond the endless ridges. Beyond the ridges they could see snow peak after snow peak, all rising from 5000 to 8000 ft or more above the deep timbered valleys. They observed that throughout the north Cascade regions almost every peak extending above 8000 ft of elevation remained snowcapped the entire year, a sight that would be most unusual 40 years later.

The U.S. Geological Survey, mapping these rugged regions in 1898, described Snow Creek Glacier as a continuous ice mass more than 2 mi long. Early photographs show Lyman Glacier as a thick ice mass more than 1 mi² in area. An early mining report, dated 1895, makes note of the fact that a glacier on the northwest side of Cascade Pass (Fig. 3) advanced a sufficient distance in 1 year to bury the tunnel entrance under 50 ft of solid glacier ice. Those great snow sentinels of the

Pacific Northwest, the towering volcanos, are described as having glaciers extending to advanced positions down the forested valleys.

Partly as a result of the rapid glacier shrinkage many volunteer workers, located in different parts of the Cascade Mountains, began making systematic measurements of the glacier variations. Otis W. Freeman, former president of Eastern Washington College of Education at Cheney, found that Lyman Glacier has receded a total distance of 1748 ft from 1907 to 1940 (1). He reports that during this time the ice has been retreating at an average rate of 40 ft a year, with the rate increasing after 1930. While on a furlough from the army, I visited the glacier in September 1944. From the summit of Chiwawa Mountain, I could look down on the glacier and see all of the area uncovered by the ice during its retreat (Fig. 4). This retreat has been so rapid that no sizable vegetation has yet grown up within the deglaciated area. Ed Kennedy and a party from the Seattle Mountaineers Club measured the recession of Easton Glacier, on the south side of Mount Baker, and found the distance from 1934 to 1940 to be 905 ft (2).

Mount Baker provides a particularly fruitful area for the study of glaciers and their relationship to climates. The large size of its glaciers and the wonderful variety of glacial deposits and related features lend themselves exceedingly well to the dating of climatic fluctuations. A glacier-crowned volcanic peak, Mount Baker is located in northwestern Washington, about 15 mi south of the Canadian border. Washington's third highest summit, it rises to an elevation of 10,775 ft above sea level and carries nine large glaciers, all but one beginning at, and radiating outward from, the summit plateau.

While I was employed by the U.S. Forest Service at Concrete during the summer of 1952, I found time on weekends to visit the Easton and Deming glaciers. These glaciers coalesce and form a continuous expanse of ice covering the entire south and southwest sides of the mountain, with only a single rock outcrop near the top marring the glistening whiteness. A government map of Mount Baker, surveyed in 1907-08, places the terminus of Deming Glacier fully $4/5$ mi beyond the present terminus, showing almost 1 mi of recession within the last 40 to 50 years.

I visited several old-timers in the vicinity who vouched for the fact that Easton Glacier occupied an advanced position near the turn of the present century. This position is now more than 1 mi beyond the present terminus. Early photographs of the glacier taken in 1917 and 1925 verify their statements. Ben Carey, of Friday Harbor in the San Juan Islands, and I measured the total recession from an orange-painted arrow made by the Seattle Mountaineers Club at the 1934 terminus and found the distance to be 2210 ft (3). In the past 18 years the ice has been retreating at an average rate of 123 ft a year.

By studying the growth layers of trees which have grown up on the terrain recently exposed by the melting of the Mount Baker glaciers, the climatic history of the region can be extended with considerable accuracy back to the middle of the 18th century. While I was working on the east side of the mountain during the summer of 1953, I found that a careful study of the growth layers revealed the recession rates and minimum time since Boulder Glacier advanced beyond a given point (Fig. 5). Morainal embankments left by the glacier along the margins and at the front of the

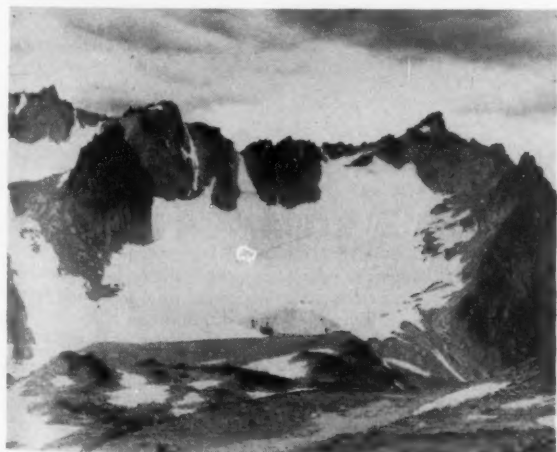


Fig. 2. Snow Creek Glacier in July 1948, showing the glacier after 40 to 50 years of melting.



Fig. 3. Glaciers on the east side of Cascade Pass, at the crest of the Cascade Mountains, showing the advanced position of the glaciers at the beginning of the 20th century. Since then these glaciers have shrunk to the base of the cirque headwall in the background. The large amount of talus and debris at the base of the cliff in the foreground predates the glaciers and is undisturbed by recent glacial action. Several thousand years may have been necessary for the talus accumulation. [Photo by Lindsley]

ice record three distinct glacier advances or recession halts. These moraines are fresh and comparatively undisturbed, with the oldest morainal set lying at the edge of the old forest where trees are 400 to 500 years old. Evidently the glacier has not advanced beyond this point for at least 400 years, since the trees would have been sheared off and destroyed by the advancing ice.

As the glacier receded, a new forest grew up on the exposed land surface. By counting the annual growth layers, I found that the trees lying behind each advanced position are nearly uniform in size and age. A minimum of 107 rings is on trees growing between the oldest and intermediate glacial deposits, 85 rings between the intermediate and youngest, and only 41 growth layers immediately behind the deposits of the youngest glacial advance. The counts give us the dates of 1846, 1868, and 1912, respectively, but they do not necessarily represent the dates of the three advances or stands of Boulder Glacier.

These dates are, of course, in error by the amount of time consumed by lag in the seeding of evergreen trees, and they can only represent the minimum time since the Boulder Glacier climaxes. A photograph of Easton Glacier taken in 1917 shows a barren glacial trough partially filled by the glacier,

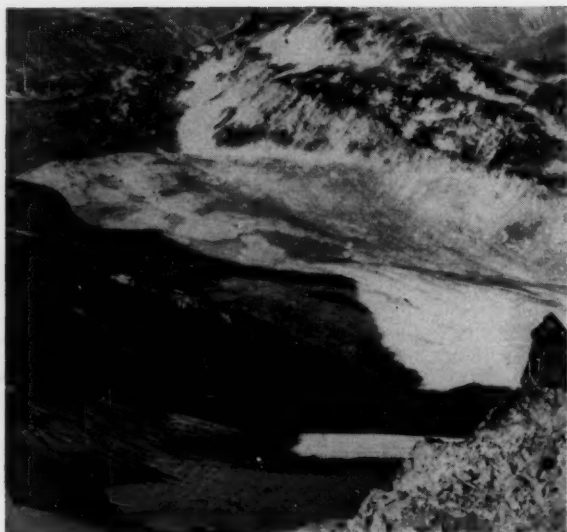


Fig. 4. Lyman Glacier in September 1944, from the summit of Chiwawa Mountain, elevation 8459 ft. Note the well-defined line separating the recently deglaciated terrain from the tree- and grass-covered ridge lying beyond. The glacier stood very near this line in 1907 and has receded about 2000 ft to its present position. There is no holdover snow to form new ice and to protect the glacier from melting.

but no trees are seen in the view. A second photograph taken from the same place in 1952 shows that the glacier had receded almost entirely from view, but trees have not yet appeared within any part of the bare glacial trough shown in the two views. Evidently in the Easton Glacier trough at least 35 years are necessary for the seeding and any substantial appearance of evergreen trees. Behind the moraines below Nisqually Glacier, on Mount Rainier 145 mi south of Mount Baker, early photographs show that the time lag in the seeding of evergreen trees varies between 35 and 50 years. (4). The indications are, therefore, that Boulder Glacier climaxed near the end of the 18th century and perhaps even earlier than this, because the oldest tree lying behind each end moraine probably was not found, with temporary halts or minor readvances about 1850 and 1880 (Fig. 6).

In addition, I noticed lying adjacent to the Boulder Glacier trough two deeply entrenched marginal streams which are now of such insignificant volume as to suggest that they could not have eroded the deep canyons they occupy. These streams arise from springs and do not have their source at the glacier. The floors of the canyons are 200 to 350 ft below the present land surface. The canyons are considerably larger and deeper than are canyons not lying marginal to the Boulder Glacier trough. The heads of these lateral canyons end at prominent gaps cut through the lateral

moraines, which were deposited by the glacier during the three stands, indicating that melt-water flowed through the gaps and eroded the lateral trenches in places deep into the underlying bedrock.

Since the stands of Boulder Glacier at the 1850 and 1880 positions were obviously of short duration, it is highly improbable that the canyons were formed during these stands. Apparently the stand of the glacier at the advanced position of $1750 \pm$ was of sufficient duration to enable the ice-marginal streams to entrench themselves and to erode such spectacular canyons. Also, the very large bulk of the $1750 \pm$ moraines, when compared with the rather small size of the 1850 moraines and the very small size of the 1880 moraines, suggests that considerable time was necessary to build them and represents a long stand by Boulder Glacier at this advanced position. The stand is in the order of several hundred years.

As is indicated by the quantities of rock debris that forms huge lateral embankments, the recession of Easton Glacier must have been balanced by its forward movement for these same hundreds of years. The lateral ridges extend unbroken from behind the present ice front a distance of about $1\frac{1}{2}$ mi, curving gradually inward near the apex and descending to a low end moraine which is breached by the melt-water stream. The



Fig. 5. Aerial photograph, 18 July 1931, showing Mount Baker from the east. Boulder Glacier is at lower center of view. At the end of the Boulder Glacier trough there is a well-defined forest trimline and end moraine separating the old forest from the new; it marks the 1750 ice front, elevation 3100 ft. Lying 1300 ft farther up the trough is a second morainal set, which marks the 1850 ice front, elevation 3400 ft. The 1880 ice front, elevation 3600 ft, lies about 1250 ft above, at the place where the trees end and the barren floor of the recently deglaciated trough begins. The present-day terminus of Boulder Glacier is at an elevation of about 5500 ft. The well-defined lateral-drainage channels mentioned in the text border the glacial trough on both sides. [Photo by Lage Wernsted, U.S. Forest Service]

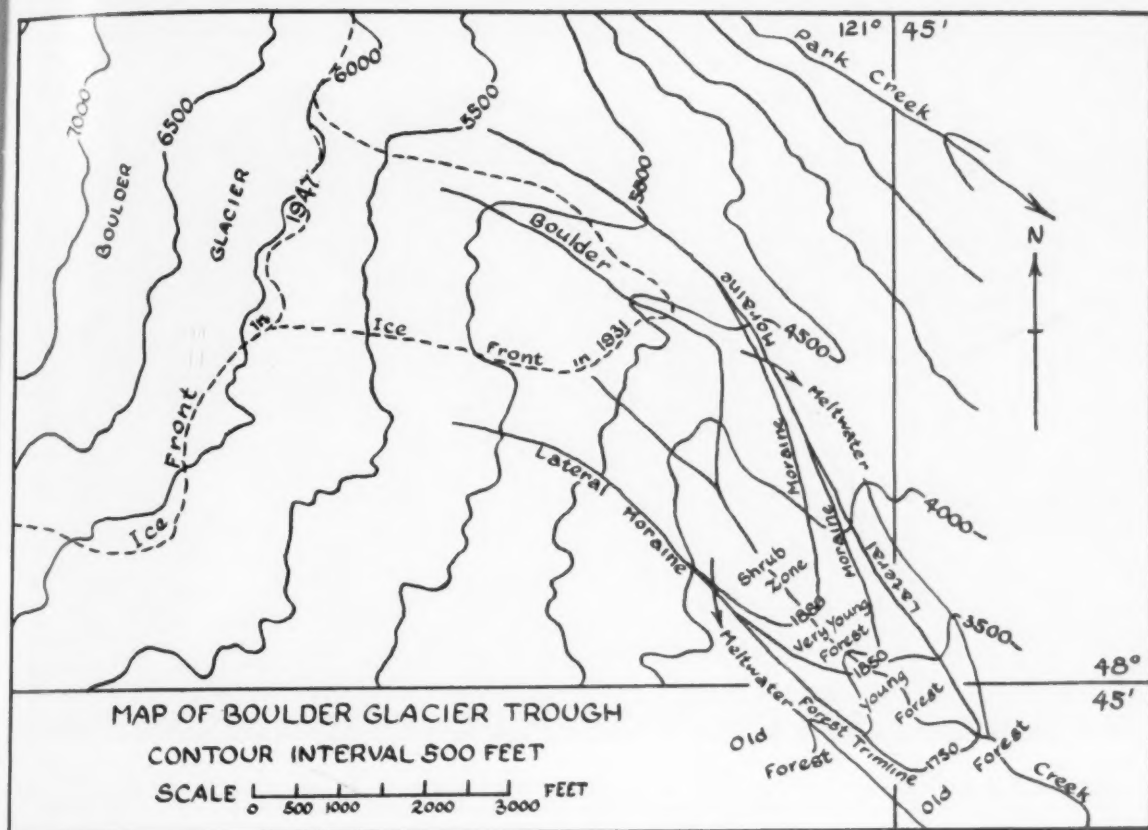


Fig. 6. Topographic map of Boulder Glacier trough, showing recent terminal positions of Boulder Glacier.

crests of the lateral moraines are sharp and narrow, overhanging and slumping very readily on the inner, or trough, side. Huge boulders continually break loose from the trough sides of the laterals and fall to the floor of the glacial trough. On the ridge side, however, the bouldery debris is firmly held in place by soil, alpine plants, and trees.

The Easton Glacier lateral moraines obviously predate the advance of $1750 \pm$, since old-growth trees are growing on the ridge or outside slope of the moraines. Not at any time within the last 400 to 500 years, or the approximate age of the old trees, could the glacier have advanced beyond the confines of the moraines, because the presence of the old forest lying immediately beyond the $1750 \pm$ terminus and on the laterals certainly precludes the possibility. If I can rightly conclude that the age of the hemlock and fir in the old forest is in the amount of 400 years, or the average life-span for these tree types, then the minimum age for the moraines is the same. During these years, then, minor climatic fluctuations caused glacier extensions of Easton Glacier that may have equaled, but apparently did not exceed, the $1750 \pm$ maximum. In the light of this interesting evidence, per-

haps we can say that our glaciers are now merely receding to the positions that they occupied toward the end of the 16th century. The age of the moraines is probably even earlier than the 16th century, because we have no way of knowing how many generations of trees have grown on the outside slope of the outer lateral moraines.

Additional field data that permit observers to extend the records of climatic fluctuations in the Pacific Northwest back much further is afforded by the lesser glaciers, particularly those on the drier east slope of the Cascades. Here the mountains are higher and are easier of access because of less vegetation and more trails. A good representative east-slope valley containing much evidence of past and present glaciation is the Entiat River Valley, located about 20 mi north of Wenatchee. I explored the Entiat Valley quite thoroughly during August 1950.

The Entiat Valley heads in a wildly picturesque region of Matterhornlike peaks and ragged glacial cirques (Fig. 7) and is a deeply excavated trough that was the channel of a long glacier tongue during the last great ice age. Many small tributaries, each with its own cirque, formed the heads of



Fig. 7. The Entiat Mountains, elevation 9200 ft, from the west. Small glaciers, or neve fields, occupy sheltered places below the cliffs. The gullied walls and talus result from an extended warmer and drier period following the last great ice age. In protected places "modern" glaciers have re-formed and have pushed the talus and debris into lateral and terminal moraines.

numerous small glaciers that coalesced in the main valleys.

The field data I found at the headwaters to the Entiat River permitted me to extend the plotted curves of climatic changes back into antiquity, perhaps as far back as the end of the Pleistocene ice age $10,000 \pm$ years ago. Following the maximum of the last Pleistocene ice age, the glaciers dwindled and disappeared because of an extended warmer and drier period. The occurrence of this warmer period is indicated by moderate amounts of talus and debris in the cirques and by the degree of post-glacial weathering on the cirque walls. Most certainly this debris could not have gathered while glaciers were present and actively eroding the mountains, since they would have removed this debris from the cirques and valley heads.

Cirques are more numerous and larger on east and north slopes than on south and west slopes, because the prevailing winds are westerly, blowing snow from the ridges and summits into the protected basins on the leeward slopes. Here glaciers re-form to enlarge preexisting cirques and to sculpture new ones. The walls of these younger cirques are steeper and somewhat smoother, standing out

in rather sharp contrast to the gullied and more subdued walls of the preexisting, or late-Pleistocene ice-age cirques. Generally, there is a break in slope at the top of the younger cirques, with well-defined gulleys ending at the break, increasing in gradient, or becoming smaller immediately below. This change in gully character I could attribute only to erosion by glaciers regenerated during a period of renewed but moderate glaciation, since, in the cirques not containing present-day glaciers, the gulleys extend uninterrupted to the floor, or disappear beneath the encumbering debris. This change is very noticeable where the schrundline, or line marking the upper level of the ice, recently has been exposed by the shrinkage of the present-day glaciers.

These regenerated, or "modern," glaciers have heaped, or pushed, the debris into very fresh end moraines which encircle the glaciers on the front and sides. The moraines are prominent and sharp-crested, with three distinct morainal sets fronting most of the glaciers (Fig. 8).

The upper Entiat moraines may date from the $1750 \pm$, 1850, and 1880 advances, which are so strikingly shown by the Boulder Glacier moraines.

If we allow a sufficient correlation of similarity to exist between the three morainal sets fronting the Mount Baker glaciers and the three sets characterizing the Entiat region, perhaps we can say that the outermost moraines in both areas represent glacier maximums reached about the end of the 16th century, with the $1750 \pm$ advance equaling, but not exceeding, this early maximum.

When one compares the extremely youthful appearance and the unstable condition of the steep sides of the Entiat moraines with the more subdued appearance and stable condition of the nearest Pleistocene moraines farther down the valleys, it becomes readily apparent that these recent moraines are not products of gradually receding Pleistocene glaciers but are products of recently formed, or "modern," glaciers.

This whole sequence of a new generation of glaciers, with attendant cirques and moraines, undoubtedly has occurred since the time of early post-Pleistocene weathering, a time of an extended warmer period resulting in the destruction of all the ice-age glaciers, except perhaps the main glaciers on Mount Rainier, Mount Baker, and Glacier Peak.

Not many of us realize that the period between 1944 and 1950 apparently brought a return of cooler climates, resulting in a minor glacier extension. A. E. Harrison (5) of the University of Washington at Seattle, Arthur Johnson, regional hydraulic engineer for the U.S. Geological Survey at the Tacoma office, Walther Hofmann (6) of the Photogrammetric Institute at Munich, Germany, and Kermit Bengtson (7) report that the shrinkage of Washington's glaciers has ended, at least temporarily. Their measurements show that Coleman Glacier, on the north side of Mount Baker, has advanced several hundred feet since 1947. They also found that Nisqually Glacier, on the south side of Mount Rainier, has thickened considerably.

I found that the terminal ice of Boulder Glacier in August 1953 was bowed outward, heavily crevassed, and overriding thin dirty basal ice. The picture on 6 September 1954, is one of much glacier activity, with the remaining thin ice being pushed forward and heaped up by the rapidly advancing central ice tongue. Aerial photographs of the glacier taken in 1947 show prominent outcrops of rock exposed by the recession of the glacier, outcrops which since have been reburied by the advancing ice.

The evidence and discussion pertaining to the north Cascade Mountain glaciers that I have presented here are essentially correlative with the observations made by Mathews (8), Cooper (9),

Lawrence (10), Sherzer (11), Field (12), Harrison, Bengtson, and others within the Cordilleran areas. To quote the words of Mathews (8, p. 379):

Thus, throughout the width of the Cordilleran area, we find the record of two climaxes of the glaciers, one at sometime within the eighteenth century, the other within the nineteenth century, earlier by a few decades perhaps in the west than in the east, but nonetheless a correlative climax.

The post-Pleistocene history of the north Cascade glaciers is essentially analogous to that of the glaciers found in other Cordilleran areas, with at least all the lesser Cascade glaciers belonging to Matthes' (13) "little ice age." The time of talus accumulation in the late-Pleistocene ice-age cirques of the Entiat region is evidence of the prolonged warmer and drier period, the "climatic optimum" as discussed by Flint (14), which followed the dwindling of the Cascade ice-age glaciers. Records of three glacial maximums for the Mount Baker glaciers are demonstrated by the immature forests growing on recently deglaciated terrain, the first near the middle of the 18th century, the second about the middle of the 19th century, and the third near the end of the 19th century. If we can rightly say that the outer Mount Baker moraines are at least 400 years old, as the trees growing on the ridge side of the lateral moraines indicate, then we can apply a limit of about 4 centuries to the more severe part of the "little ice age."

The foregoing and other obtainable information show that the Cascade Mountain glaciers apparently reached a maximum about the middle of the 18th century, and since about 1880 have been



Fig. 8. Isella Glacier on the east side of Bonanza Peak, elevation 9511 ft, from the summit of Dumbell Mountain, elevation 8421 ft. Note the undisturbed talus at the base of the cirque wall on the right, while at the center the present-day glacier has pushed the talus into a sharp-crested moraine. The area is near the mining town of Holden in the vicinity of Lyman Glacier.

shrinking at a rapid rate. Although the world-wide mean annual temperature has increased several degrees within the past 100 years, brief colder periods, each less severe than the preceding one, have temporarily halted the glacier recession, with distinct swings to climatic maximums resulting in glacier readvances. This temperature rise is very likely the main cause of the glacier shrinkage in the Cascades. Local climatic studies such as these, when applied over a broad geographic range, result in accurate correlations and generalizations regarding past climate and glacier fluctuations. One of the best indicators, therefore, of the general trend of climates in the Cascade region, or any region, is the condition of the glaciers throughout these regions at any time.

Men wonder why the climate is continually changing from one extreme to the other. Each generation, being dissatisfied with the prevailing weather, has attributed these changes to a rather wide assortment of natural and artificial phenomena. Scientists are not in agreement why the climate was at least as cold and severe near the middle of the 18th century as it was at any time since the end of the last great Pleistocene ice age. We do not know exactly why the climate is getting warmer. We can merely observe the results of climatic fluctuations and theorize regarding their cause. The farther back we push our plotted curves of climatic

changes, the less obvious, or living, so to speak, are our data, until the years crowd together and our evidence becomes more and more circumstantial.

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Gastropod Infected with Boring Sponge

The cover this month is an x-ray photograph of *Fasciolaris tulipa* Linné infected with the boring sponge *Cliona* sp. The shell, which was taken from Sanibel Island, is in the museum of the Marine Laboratory, University of Miami, Coral Gables, Florida. Charles E. Lane, who contributed the photograph, states that there is no clear superficial evidence of infection in the shell. However, the x-ray unmistakably reveals the invasive process. The museum records do not indicate whether the infection occurred during the life of the gastropod or whether it was a post-mortem event. The sponge has been reported in both living and dead shells. According to Lane, little is known of the precise ecology of the relationship between the sponge and the shell in which it lives. He thinks that it is reasonable to assume that the boring habit in the sponge, no less than in other boring forms, is related to specific metabolic requirements of the organism. This photograph illustrates one of the complex of interrelationships that constitute the mineral turnover in the sea.

Our Responsibilities as Scientists

J. RUD NIELSEN

Dr. Nielsen is research professor of physics at the University of Oklahoma. A native of Denmark, he was trained at the University of Copenhagen and taught at the Danish Royal Technical College before coming to the United States in 1922 as a fellow of the American-Scandinavian Foundation. After a year of research at the California Institute of Technology and a year of teaching at Humboldt State College, he joined the University of Oklahoma faculty. From 1931 to 1933 he held a Guggenheim Memorial fellowship and worked with Niels Bohr in the Institute of Theoretical Physics at Copenhagen. Dr. Nielsen's researches have been mostly in the fields of molecular structure and infrared and Raman spectroscopy. This article is based on an invited address delivered at the annual meeting of the Oklahoma Academy of Science held at Shawnee on 4 December 1953.

AFTER the Renaissance, the Reformation, and the voyages of discovery had broadened and liberated the minds of men, science emerged in the 17th century as an important factor in our civilization. During the next two centuries, Newton's mechanics and later the theory of evolution exerted profound influence upon Western thought. The revolutionary developments of 20th-century physics, the theory of relativity and the quantum theory, are now making their impact.

Science played only a minor role in the invention of the steam engine and in initiating the Industrial Revolution. However, during the last 100 years its applications to medicine and technology have become ever more numerous and fruitful. Life-expectancy has increased, productivity has risen so as to make possible a widespread economy of plenty, and new means of transportation and communication have made the world smaller and have made its peoples more dependent on one another. In turn, the growth of science has been greatly aided by the prosperity resulting from the practical applications of scientific discoveries. The progress of science has also been facilitated by the rise of democratic practices and ideals, in particular by the gradual increase in intellectual freedom. However, although the benefits of science have been very great and promise to be vastly greater in the future, it is undoubtedly true that our most difficult problems today have either been brought about or been aggravated by scientific advances.

These problems are of three kinds. First, there are the internal cultural conflicts resulting from rapidly changing patterns of living and from the constant necessity of discarding old ideas and developing new concepts. Like most transition

periods, ours is a time of uncertainty and confusion. Second, there is the all-important problem of preventing war. Because of epoch-making advances in applied nuclear physics and the development of guided missiles and other weapons of destruction, it is hardly an exaggeration to say that success in solving this problem spells the difference between survival and suicide for the human race. Third, there is the immense problem of creating a basis for lasting peace by developing the world's resources so as to satisfy the needs of a population that is at present increasing faster than the food supply. Of course, these three groups of problems are not independent, and the East-West conflict that dominates international relations today, and even domestic politics, is part and parcel of each of them.

Now, in this world of endless opportunities and great dangers brought about by science, what are our responsibilities as scientists and citizens? Well, there is at least one thing for which we are not responsible: namely, the laws of nature being what they are. It is also clear that a worker in pure or basic science cannot be held responsible for the specific consequences of his discoveries, for these can never be foreseen when a discovery is made. With workers in applied science the matter is different. Their work is directed toward definite ends, for which they certainly should be responsible. However, their responsibility is limited by the fact that they usually have little or no control over the uses to which their gadgets or processes are put. Thus, the scientists who developed radio and television can hardly be held accountable for the truth of the information broadcast or for the artistic quality of the TV programs. Nevertheless, in a

general way every scientist should feel responsible for the consequences and his work and his science. As Einstein once said:

Concern for man himself and his fate must always form the chief interest of all technical endeavors. Never forget this in the midst of your diagrams and equations.

It is clearly our duty to be as good scientists as our abilities and opportunities permit. This means, first of all, that we should cultivate those attitudes that are essential for scientific work: intellectual integrity, respect for facts, tolerance, courage, and humility. We should be prepared to defend science and should exert every effort to bring about such conditions that science can flourish. Whenever necessary, we should muster the courage to fight for intellectual freedom and for the freest possible flow of scientific information. In doing so, we should make clear to our fellow-citizens that we claim these freedoms, not in our own interest, but because they are essential for the progress of science.

In the early days, scientists were allowed to investigate largely because few people paid attention to them. As Spinoza once said,

Had mathematics, in the eyes of men, the same kind of interest as politics, perhaps mankind would never have known what truth is.

This situation has changed. We are now very much in the public eye, and intellectual freedom has been curbed behind the Iron Curtain and elsewhere, and it is being threatened even in our own country by groups dominated by fear and ignorance. We owe our freedom largely to the courage of religious and political dissenters. However, we must now assume a greater share of the responsibility for upholding freedom of thought and inquiry.

Outside the laboratories one of our chief responsibilities is to help spread information about the results of science and to impart some understanding of scientific method to our fellow-citizens who have had no scientific training. The popularization of science is a difficult job, and not many of us are good at it. However, it is a collective duty that we must take seriously. We should endeavor not only to give information but also to promote those attitudes that are bound up with science. With tact and understanding, we should combat prejudice, intolerance, and all forms of absolutism.

I believe that we can contribute to the solution of some of the present conflicts and to the emergence of a more integrated culture by passing on to others some of the lessons we have learned from

modern science. One of the difficulties troubling this generation is the continual necessity of renouncing old ideas and developing new concepts to cope with new facts; and this is a mental process in which scientists have unique experience.

Thus, the study of atomic and molecular phenomena has forced physicists to abandon many of their most fundamental concepts and think in a radically new way characterized by Bohr's principle of complementarity. According to this principle, atomic phenomena can be completely described only with the use of different sets of concepts, which are contradictory or mutually exclusive when applied with too great precision. Thus, to account for the behavior of electrons, both the concept of particle and the concept of wave are needed, but they must be used with just enough latitude or fuzziness to avoid contradiction. A causal space-time description, as was hoped for in 19th-century physics, is not possible, and the old claims for objectivity have been revised.

Bohr has applied his concept of complementarity to a number of general problems outside the realm of physics, such as the problem of free will versus determinism and the question of whether or not biological phenomena can be described in terms of physical science alone. He has not resolved these dilemmas, but he has mitigated them by placing them in a new epistemological setting.

Now, if the simple phenomena of physics require diverse viewpoints, this must be even more true for the complex issues about which conflicts rage at present, and this is something we should make clear whenever possible. We should encourage the adoption of a "both-and" attitude in place of the "either-or" supposition of most public discussions. Thus, in the controversy over collectivism versus individualism, we should make clear that both are equally indispensable. Civilization, perhaps even life, could not exist without a considerable measure of collectivism. On the other hand, many human activities, including scientific work, require a large amount of individual initiative. It is usually futile to argue about which of two such extremes is the lesser evil. It is profitable only to search for the proper balance. The Greeks recognized this more clearly than we do today; and we in this country could learn something about balance and harmony from the small nations of northern Europe.

In public discussions much confusion and misunderstanding arise because speakers fail to make their different viewpoints clear. As scientists we have a special responsibility to make clear the position from which we speak. Moreover, we should always adopt points of view as general as possible, so that we may have the largest possible

ground is common with those with whom we talk. Special tenets of professional, partisan, or sectarian nature should always be left out of public discussion. A fundamentalist and an atheist can have a profitable discussion about religion only if both, for the purpose of the discussion, adopt an agnostic point of view and use the word *god* to designate a prevalent and important human concept.

In discussions with nonscientists we should always be patient and friendly. We should keep in mind that many of their problems are directly or indirectly caused by science. If they have had to give up old ideas, or if cherished beliefs have lost their old meanings to them, we should be ready to help them find new ideas or new meanings. It is often claimed that science is concerned only with facts and has no regard for values. There is some truth in this. However, for psychology and sociology values are facts; and it is wrong to assume that science has nothing to offer as a basis for ethics. Indeed, the very integrity that forbids the scientist to let feelings or human value judgments color facts is an ethical quality, as are many of the other principles or attitudes that are prerequisites for, or by-products of, scientific work. In some scientists, at least, they may well be said to constitute what Einstein called a cosmic religion.

If scientists are to render effective aid in resolving cultural conflicts, they must find means of overcoming the handicaps of specialization; that is, they must strive to have broad knowledge and wide interests. There can be no question, of course, of doing away with specialization. Scientific problems are usually very difficult and are rarely solved except by prolonged labor of scientists who have spent years studying a particular field. Specialization is also dictated by economy. Think of the funds that would be needed for equipment if scientists would change their research fields every 2 or 3 years! Actually, I believe that the evils of specialization have been exaggerated. Competent work in most research fields requires a wide range of knowledge far transcending the field in question. One sometimes hears critics deplore the fact that science is being split up into more and more minute subdivisions. What the critics overlook is that each of these subdivisions has generally far greater content than the parent science had a few decades ago.

So much for our responsibility for cultural integration.

During World War I, the British physicist Rutherford once missed a meeting of a war research committee. He apologized for his absence in a letter saying that he had been busy with experiments in which he seemed to have split an

atomic nucleus. "If this is true," he added, "it is more important than your war." Rutherford had knocked a proton out of a nitrogen atom, and his remark referred only to this important advance in basic nuclear physics.

Some 20 years later, Hahn and Strassmann in Germany obtained some puzzling results by bombarding uranium with neutrons. The Austrian Jewess Lise Meitner, who just then had to leave Hitler's Reich, interpreted these results as evidence for a splitting of the uranium nucleus in two nearly equal parts and calculated the large amount of energy that should be released in such a process. Her idea was brought to the United States by Bohr in January 1939, and he and Fermi recognized the possibility of producing nuclear chain reactions with enormous releases of energy. This was accomplished in December 1942, and the first atomic bomb was exploded in July 1945. No events have added more to the responsibilities of scientists.

The first public evidence that the scientists who had developed the atomic bomb were ready to assume their new responsibilities was an article, "Science and civilization," published by Bohr on 11 August 1945, 4 days after the destruction of Hiroshima, in the *London Times* and also in a Danish newspaper. Bohr wrote in part as follows:

Civilization is presented with a challenge more serious, perhaps, than ever before, and the fate of humanity will depend on its ability to unite in averting common dangers and jointly to reap the benefit from the immense opportunities which the progress of science offers. . . . In the great task lying ahead, which places upon our generation the greatest responsibility towards posterity, scientists all over the world must offer most valuable services. Not only do the bonds created through scientific intercourse form some of the firmest ties between individuals from different nations, but the whole scientific community will surely join in a vigorous effort to induce in wider circles an adequate appreciation of what is at stake and to appeal to humanity at large to heed the warning which has been sounded. It need not be added that every scientist who has taken part in laying the foundation for the new development, or has been called upon to participate in work which might have proved decisive in the struggle to preserve a state of civilization where human culture can freely develop, is prepared to assist in any way open to him in bringing about an outcome of the present crisis of humanity worthy of the ideals for which science through the ages has stood.

In this country the first effort of atomic scientists was an attempt to persuade President Truman not to use the bomb but to invite representatives from Japan to a demonstration of its destructive power.

When they failed in this, they banded together to work for legislation placing the further development of atomic energy under civilian administration and to promote international control of atomic energy. They founded a journal, the *Bulletin of the Atomic Scientists*, which is now the leading magazine for science and public affairs.

Atomic energy was put under a civilian commission. However, all efforts at reaching an agreement with the U.S.S.R. for control of atomic energy have failed, and East-West tension has increased, while new and more devastating atomic weapons have been developed, not only here, but also in the U.S.S.R. In this dangerous situation, scientists—and especially nuclear physicists—have grave responsibilities.

They must, first of all, continue to help government and military leaders understand the facts about atomic energy and other physical phenomena relevant to modern warfare. They must try to make clear to these leaders and to themselves what the role of science would be in another world war and what such a war would be like. Oppenheimer, the American physicist who headed the Los Alamos Laboratory during World War II, once said to a government committee: "I can't tell you what to do, but I can tell you what makes sense and what doesn't make sense." The British physicist who developed the radar system used by the RAF, Sir Robert Watson-Watt, wrote 3 years ago in the *Bulletin of the Atomic Scientists*:

There is no greater necessity in the world of today than a closer understanding by the politician and the citizen of the motives and methods of science, and by the scientific worker of the inevitability of politics and the responsibilities of citizenship.

In a time like this, scientists have an obligation to help make the nation strong. This means, among other things, to see to it that basic scientific research is carried on at a high level and in the most effective manner. It also means, unfortunately, that a large number of scientists must engage in military research and in the development and evaluation of new weapons, for at the present time, a country's military strength depends less upon the number of weapons it has than upon their kind and quality. Scientists working on military problems must forego the right to publish and must submit to cumbersome, and sometimes unreasonable, security restrictions.

About \$1.5 billion is spent annually in this country on military scientific research. There is danger that this kind of research will be regarded as a substitute for basic research and that the re-

strictions appropriate to military research will be gradually carried over to basic research. It is up to us as scientists to combat this danger. As Sir Henry Dale, president of the Royal Society of London, said some time ago:

I think that we, as scientists, should make it clear to the world that, if national military secrecy were allowed thus progressively to encroach upon the freedom of science, even if civilization should yet for a while escape the danger of final destruction, a terrible, possibly a mortal, wound would have been inflicted on the free spirit of science itself, to the immeasurable loss of what it stands ready to offer to a wiser world.

The development and conservation of natural resources and, not least, the exploration, and development of peacetime applications of atomic energy, and of the many by-products of nuclear reactors will greatly strengthen the nation, and are among the most important responsibilities of scientists of many kinds.

Since we can hardly hope to escape war unless something is done to reduce the present world tension, scientists should do what they can toward this end. Science is international. It has progressed by close collaboration of workers in many countries. In my own case, I have worked for a quarter of a century in a field opened up by a dark-skinned Dravidian from southern India and independently by two Russian physicists. Most scientists have frequent correspondence with foreign colleagues, and many of us have made friends at international meetings. We know that the human race is one species. We know that all men are essentially alike and that all nations hope to avoid war. Although our influence may not be great, we should do all in our power to widen international cooperation. We should support, and be willing to take part in, any efforts by the United Nations or other international agencies that will increase mutual confidence among the peoples of the earth.

Although the prevention of war is the most urgent task today, the greatest long-range endeavor should be to create such a world order that lasting peace may become possible. This means, first of all, to raise the standard of living for the 70 percent of the world's population that is now undernourished. This is a colossal but inspiring program for which many scientists must assume a large share of responsibility.

The first tremendous problem is that of increasing the world's food production by better farming practices and soil management, improved seeds and livestock, insect control, and so on, and by irrigation projects in arid regions. Research on means of making the tropics habitable and produc-

tive, on better utilization of the oceans as food supplies, and on the use of algae as a source of protein should contribute to this end. I understand that significant results may be expected in such a program with rather limited expenditures.

Next comes the problem of developing power resources and creating industries. This is again a task for scientists, engineers, and technicians, and it is a program that will require large capital investments. Finally, there is the problem of markets and trade. Although the restriction of trade by tariff barriers may be of immediate benefit to some industries in this country, it will undoubtedly be to our long-range advantage to gear our economy as much as possible to that of the rest of the world and to make whatever adjustments in our economic system that may be required to insure its stability.

Some people may feel that I have lost my sense of proportion. How can we assume responsibility for the welfare of the entire world?

Frankly, I believe that this country must assume a large measure of responsibility for the welfare of the world if it is to discharge the obligations of the leadership to which it has so recently fallen heir. We must do so out of self-interest, if for no higher reason. If we do not show the poor and hungry nations that we care for them and are willing to help them, we shall not win their friendship, and they may turn elsewhere for leadership. President Truman recognized this when he proposed his Point Four program. Although this program was implemented on a rather small scale and was partly converted into a military-aid program, it is doing a great deal of good and is creating a lot of good will for this country. I believe that such a technical-aid program is as essential for the security of the United States as atomic bombs and battleships are.

The privilege of working in the Point Four program is open to few of us. However, a number of us may have a part in the training of experts or technicians for work in underdeveloped countries, and others may contribute to the solutions of some of the scientific problems underlying or raised by this program. The experts or technicians that we send overseas should not be too narrowly trained. In addition to their specialty, they should know something about the history and culture of the people with whom they are to work. They should be able to learn as well as to teach, so that the program can be a give-and-take affair.

There are, of course, many difficult and perplexing problems connected with such a program. There are problems of timing and of determining the optimum rate of development in each area.

The development should not be so rapid as to exhaust the natural resources or to cause too great strain on existing social and cultural patterns. A formidable problem in some places is that of preventing populations whose death rates are reduced by improved medical care and sanitation from increasing faster than the food supply. In India, for example, the increase in population is so rapid that a Government Planning Commission reported in 1951 that:

With all the effort that the First Five-Year Plan will represent, it will be possible barely to restore by 1955-56 the pre-war standards in regard to food and clothing. Increasing pressure of population on natural resources retards economic progress and limits seriously the rate of extension of social services so essential to civilized existence.

This is a discouraging statement, not least in view of the low standard of living prevailing in India before the war.

The population of the world has almost doubled in my lifetime and now increases at the rate of 23 million per year. Overpopulation is inevitable, unless the birth rate falls sufficiently with the rising standard of living, as it has done in Europe and in this country. In fact, with the birth rate of the year 1800 and the 1950 death rate, the population of Massachusetts alone would increase in 100 years to 2.4 billion—that is, to the size of the present population of the entire earth. Measures may have to be taken to lower the birth rate artificially in many countries. Certainly, the factors that determine birth rate need to be studied carefully by biologists, social scientists, public-health experts, religious leaders, and others.

Like most of the other problems created by the impact of science upon society, the population problem presents its own ethical dilemma. In his presidential address given in 1952 to the British Association, the biologist, Nobel prize winner, and member of Parliament, A. V. Hill, raised the question of whether it would not be wise to hold back the application of medicine and hygiene from backward people in order

... to keep in step with other parallel progress so that development could be planned and orderly? Some might say yes, taking the purely biological view that if men will breed like rabbits they must be allowed to die like rabbits, until gradually improving education and the demand for a higher standard of living teach them better. Most people would still say no. But suppose it were certain now that the pressure of increasing population, uncontrolled by disease, would lead not only to widespread exhaustion of the soil and of other capital resources but also to continuing and increasing internal tension and disorder, making it hard for

civilization itself to survive. Would the majority of humane and reasonable people then change their minds? If ethical principles deny our right to do evil in order that good may come, are we justified in doing good when the foreseeable consequence is evil?

I do not believe a general answer can be given to this question. My answer would depend on what the foreseeable consequence is and with what degree of certainty it is known. But these are matters to be determined only by scientific and statistical research.

Although my background in this field is poor, I have tried to read a number of papers on world resources and population. The fact that half of these papers take an optimistic view and half of them a gloomy one indicates to me that there is a great need for basic research in this extensive and complex field. Because of the unique position of this country in the world of today, it seems to me that American scientists should assume a major share of responsibility for this work.

I would like to point out that all three of the general problems I have discussed are essentially psychological in nature. This is certainly true of the cultural conflicts brought about by the impact of science. It is true also to a large extent of the danger of world war. If the less pessimistic resources-and-population experts, such as Lord Boyd Orr, are right, it is true of the problem of raising living standards in underdeveloped countries. This is a unique situation in the history of mankind and one for which science is responsible. Psychologists, including workers in the new field of social psychology, therefore appear to have special responsibilities, but all of us should recognize this aspect of the problems. As Einstein wrote 7 years ago:

If I had a child who wanted to be a teacher, I would bid him Godspeed as if he were going to a war. For indeed the war against prejudice, greed and ignorance is eternal, and those who dedicate themselves to it give their lives no less because they may live to see some fraction of the battle won. They are the commandos of the peace, if peace is to be more than a short armistice.—JAMES HILTON.

Science has brought forth this danger, but the real problem is in the minds and hearts of men. We will not change the hearts of other men by mechanism, but by changing our hearts and speaking bravely. . . . When we are clear in heart and mind—only then shall we find courage to surmount the fear which haunts the world.

I would like to conclude this article with a couple of passages from an article entitled "A world I'd like—an unprophetic vision" [*The Nation*, 7 Nov. 1953] by Bertrand Russell, the well-known British philosopher, mathematician, and Nobel prize winner for literature. In the middle of this article he writes:

I am no prophet, and I cannot tell what mankind collectively will decide. It may decide that it has existed long enough and that it is time to yield place to the animals we have hitherto called "lower." This is the view of most practical statesmen and of those who are called realists. People who like myself think that it would be a good thing if the human race continued to exist expose themselves to liquidation if they are Russians and to accusations of fellow-traveling if they are Western.

He ends the article with the following paragraph.

If, however, the reign of fear can somehow be ended on both sides of the Iron Curtain—or if not ended, at any rate be made less virulent—intelligence and skill, which have never before been so great as they are at the present moment, and which are, in fact, the very cause of our present dangers, may be turned into fruitful channels, and our grandchildren may look back to our time as the last moment of the dark ages from which, as from a long tunnel, mankind will have emerged into the sunshine and happiness of mutual harmony.

Let us do our best to make this vision come true.

Karl Wilhelm Feuerbach, Mathematician

LAURA GUGGENBUHL

Dr. Guggenbuhl is assistant professor of mathematics at Hunter College in New York. She received her training at Hunter College and Bryn Mawr College. This article is based on a paper presented by the author before Section L, History and Philosophy of Science, at the Boston meeting of the AAAS, December 1953.

ONE of the most important theorems of the geometry of the triangle that was developed during the 19th century says that "the nine point circle of a triangle is tangent to the inscribed and to each of the three escribed circles of the triangle." The theorem was discovered and first proved by Karl Wilhelm Feuerbach, a little-known mathematician who led a short and tempestuous life. Although modern textbooks in college geometry discuss the theorem at great length, a search for additional details has been extremely interesting and fruitful (1). Furthermore, it seems that few people realize that Feuerbach, the mathematician, was a member of the famous Feuerbach family of Germany.

An early date in this story is 1821. It was in this year that Brianchon and Poncelet proved (2) that

... the circle through the feet of the altitudes of a triangle also passes through the midpoints of the sides, as well as the midpoints of the segments of the altitudes from their point of intersection to the vertices of the triangle.

Brianchon and Poncelet did not seem to have any idea that the circle in question would attract the interest of so many mathematicians in years to come. They did not give a name to the circle, and after a page or two they went on to another problem.

At almost the same time, a slender little volume of a bare 62 pages appeared in Nuremberg under the formidable title *Eigenschaften einiger merkwürdigen Punkte des geradlinigen Dreiecks und mehrerer durch sie bestimmten Linien und Figuren. Eine analytisch-trigonometrische Abhandlung* (Properties of some notable points of a plane triangle, and various lines and figures determined by these points, an analytic-trigonometric treatise). The title page of this book describes the author as Karl Wilhelm Feuerbach, doctor of philosophy. It

may be that the book was Feuerbach's doctoral dissertation, but it is not possible to be certain whether this was the case or not. Feuerbach attended several different schools and universities, but a careful search has failed to uncover the title of his dissertation or the name of the university that awarded him the doctor's degree. At any rate, with the appearance of this book in 1822, Feuerbach completed his college studies at the University of Freiburg (Br.).

This book probably would have been long since forgotten had it not been for an inconspicuous theorem at the bottom of page 38, which states simply,

... the circle which passes through the feet of the altitudes of a triangle is tangent to all four circles, which in turn are tangent to the three sides of the triangle. ...

Feuerbach's proof was purely algebraic and admittedly modeled upon the proof in an article by Euler (3) of 1765. Feuerbach showed that the two circles in question were tangent by proving that the distance between the centers was equal to the sum of the radii of the circles. In outline, the proof sounds simple enough. However, one can appreciate the skill and patience that led to this discovery only by working out the details of the algebraic identities involved in the development.

Feuerbach gives only three or four references in addition to the article by Euler. It is particularly interesting to note that he refers to an article by L'Huilier, dated 1810, which appeared in Gergonne's *Annales de mathematiques*, and thus indicated that he was familiar with the journal that carried the aforementioned article by Brianchon and Poncelet. However, Feuerbach makes no reference to the work of Brianchon and Poncelet and was probably unaware of its existence.

One can scarcely say, as some writers claim, that Feuerbach discovered the nine-point circle of a

VI. Inuestigatio distantiae punctorum G et H.

17. Pro hoc casu postremo habetur:

$$AR-AS = \frac{c+b-a}{2} - \frac{1}{2}c = \frac{b-a}{2}$$

$$RG-SH = \frac{\frac{1}{10}A}{\frac{c+b-a}{2} - \frac{1}{2}c} - \frac{c^2aa+bb^2cc}{\frac{1}{10}A} = \frac{(a+b)^2 + (aa+bb^2cc) - (c+\frac{1}{2}a+\frac{1}{2}b)(a+b+c)}{\frac{1}{10}(a+b+c)A}$$

quarum binarum formularum quadrata si addantur reperitur sequens expressio:

$$GH^2 = \frac{a^2bc}{10(a+b+c)A} \left\{ \begin{array}{l} +a^4 + a^3b + ab^3 + abc^2 - 2a^2bb - 2aab^2 \\ +b^4 + a^2c + ac^2 + ab^2c - 2a^2cc - 2aac^2 \\ +c^4 + b^2c + bc^2 + a^2bc - 2b^2cc - 2bb^2c \end{array} \right\}$$

quae per $a+b+c$ reducta abit in hanc:

$$GH^2 = \frac{a^2bc}{10(a+b+c)A} \left\{ \begin{array}{l} +a^4 + aabc - 2aabb \\ +b^4 + abbc - 2aac^2 \\ +c^4 + abcc - 2bbcc \end{array} \right\}$$

Vnde facta substitutione colligitur

$$GH^2 = \frac{r}{10pA} (p^2 - 4ppq + 9pr) - \frac{r(p^2 - \frac{1}{2}p^2 + \frac{1}{2}r)}{10A}$$

scu $GH^2 = \frac{r}{10A} - \frac{r}{p}$.

Tom. XI. Nou. Comm.

P

18. En

triangle. For at no place in his book does he mention the three points that are the midpoints of the segments of the altitudes from the orthocenter to the vertices of the triangle, and he does not letter these points on his diagram. Feuerbach's description of the circle that was to become so closely associated with his name was merely the unimaginative phrase "the circle which passes through the points M , N , and P (the feet of the altitudes of the triangle)." It is nevertheless a fact that in Europe the circle is usually called the circle of Feuerbach. It seems too that Feuerbach did not realize that this one theorem was so much more significant than the others with which it was listed, and he surely did not realize that his fame as a mathematician would rest upon this single theorem.

Shortly after the publication of his book, Feuerbach, only 22 years old and without previous teaching experience, was named professor of mathematics at the Gymnasium at Erlangen. There is nothing else to indicate that the book made a deep impression upon contemporary mathematicians, or even that it had a wide circulation. In fact, 11 years later (in 1833) Steiner, writing from Berlin, said he did not know that the theorem in question had been previously proved by Feuerbach (4). In another note at the end of his book, Steiner said that the "circle is now generally known as the circle of Feuerbach." In 1842 the theorem was again submitted as an original contribution to mathematical literature and proved anew by Terquem (5). It is in this article by Terquem that the circle is first designed as the nine-point circle.

In succeeding years many articles were written

114

SOLVTIO

18. En ergo sub vno conspectu quadrata ex horum interuallorum:

- I. $EF^2 = \frac{r}{A} - \frac{1}{2}(pp-2q)$
- II. $EG^2 = \frac{r}{A} - pp + 3q - \frac{r}{2}$
- III. $EH^2 = \frac{r}{A} - pp + 2q$
- IV. $FG^2 = -\frac{1}{2}pp + \frac{1}{2}q - \frac{r}{2}$
- V. $FH^2 = \frac{r}{A} - \frac{1}{2}(pp-2q)$
- VI. $GH^2 = \frac{r}{A} - \frac{r}{p}$

Portions of pages 113 and 114 of Euler's article "Solutio Facilis Problematum Quorundam Geometricorum Difficillimorum." Here we see the development of a series of algebraic identities concerning the sides of a triangle. [Zentralbibliothek, Zurich]

about the nine-point circle. People seemed to be fascinated by the difficulties in Feuerbach's proof and seemed to find it a pleasant challenge to produce a different and far simpler proof. Two particularly detailed and exhaustive treatments appeared almost simultaneously near the end of the 19th century, one an article by the well-known Mackay (6), and the other an article by Julius Lange, professor of mathematics at the Friedrichs Wederschen Ober-Realschule in Berlin (7).

It is a little strange that so much has been written about the theorem Feuerbach discovered and that so little has been written about the man who discovered the theorem. In an article by Moritz Cantor (8) a few pages are devoted to biographical details, but by far the most poignant story of Feuerbach's short life can be read in his father's letters (9).

Karl Wilhelm was the third son in a family of 11 children born to the famous German jurist, Paul Johann Anselm Feuerbach, and Eva Wilhelmine Maria Troster. The first eight children in the family were boys, and the last three were girls. Since three of the boys died in infancy, Karl is usually spoken of as the second of the five sons of the jurist. These five sons were Joseph Anselm (1798-1851) philologist and archeologist, and father of the famous German painter, Anselm Friedrich (1829-1880); Karl Wilhelm (1800-1834), mathematician, the subject of this article; Eduard August (1803-1843) professor of law at the University of Erlangen; Ludwig Andreas (1804-1872), famous philosopher; and Friedrich Heinrich (1806-1880), orientalist.

Karl was born in Jena 30 May 1800. His father, 25 years old when Karl was born, had left his home in Frankfurt at the age of 16 to study philosophy at the University of Jena. However, since there were jurists and public servants on both sides of his family, it is not surprising to learn that, as his family responsibilities increased, he was soon attracted to the more lucrative profession of the law. All manner of success came to him at a very early age. But it was a number of years before his own father, who had been angered when he left home, became reconciled to him. The young man sent many entreating letters to his father that remained unanswered. It is in one such ingratiating letter that one can read the earliest reference to Karl; his father says, in a letter from Kiel dated 16 November 1802, that "his youngest son Karl is a healthy, red cheeked, fat youngster, who runs around happily and has little thought for anything except food." In 1804 the father writes of taking his wife and three young sons with him from Kiel to Landshut in an open wagon in freezing winter weather.

As increasing fame and success came to the father, he moved frequently from one city to another in Germany. Thus Karl, while still a young boy, lived successively in Jena, Kiel, Landshut, and Munich. When Karl was 14 years old his father moved again from Munich to Bamberg. At this

time, however, he left his two oldest sons, Anselm and Karl, in school in Munich. In 1817 Anselm and Karl entered the University of Erlangen. At Erlangen they studied under the patronage of King Maximilian Joseph, who had ennobled their father, and who had promised to provide for the university education of all the jurist's sons.

By 1819 the father had become president of the court of appeals in Ansbach. In an 1819 Christmas letter from Ansbach to his father, the jurist writes at great length about Karl's gifts in mathematics and physics. He says that Karl had given some thought to jurisprudence as a profession, but that it was his present ambition to become an engineer in the army.

After a short stay at Erlangen, Karl transferred to the University of Freiburg (Br.). He did so in order that he might continue his studies in mathematics with Karl Buzengeiger, who is credited with having had a great influence upon the young mathematician. In fact, Feuerbach's 1822 publication *Eigenschaften einiger merkwürdigen punkte* . . . features an introduction (of 16 pages) by this same professor. No doubt Buzengeiger wished to use this means to introduce a talented young student to the academic world. However, in his introduction, he says scarcely a word about the student or any of the geometric discoveries that followed in the ensuing pages.

$$\overline{OS}^2 = (AF - AP)^2 + (OP - SF)^2.$$

Nun ist aber $AF = \frac{1}{2}(-a + b + c)$ und $AP = \frac{-a^2 + b^2 + c^2}{2c}$, folglich:

$$AF - AP = \frac{(a - b + c)(a + b - c) - c(a + b - c)}{2c};$$

ferner, weil (§. 55.) $OP = \frac{(-a^2 + b^2 + c^2)(a^2 - b^2 + c^2)}{8c\Delta}$, und (§. 2.) $SF = \frac{2\Delta}{a + b + c}$,

so ist:

$$OP - SF = \frac{(-a^2 + b^2 + c^2)(a^2 - b^2 + c^2) - c(-a + b + c)(a - b + c)(a + b - c)}{8c\Delta}.$$

Substituiert man nun im Ausdrucke für \overline{OS}^2 , so wird man denselben endlich in diese Form bringen können:

$$\overline{OS}^2 = \frac{(-a + b + c)^2(a - b + c)^2(a + b - c)^2 - (-a^2 + b^2 + c^2)(a^2 - b^2 + c^2)(a^2 + b^2 - c^2)}{32\Delta^2},$$

woraus sich durch Einführung der Kreishalbmesser r, ρ, R ergibt:

$$\overline{OS}^2 = 2r^2 - 2\rho R$$

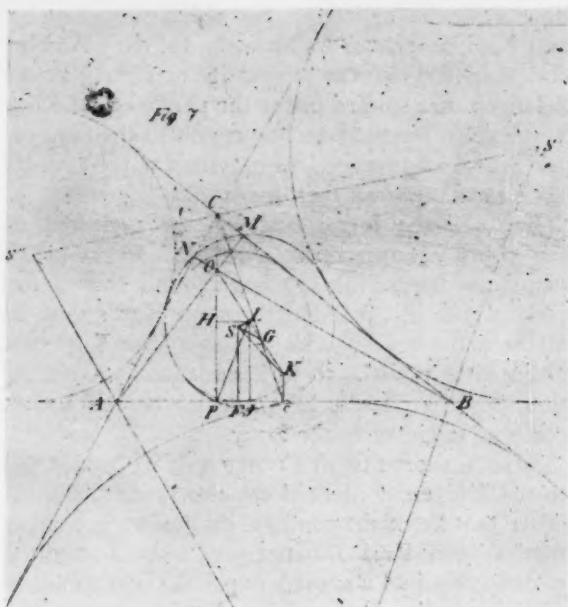


Diagram used in *Eigenschaften einiger merkwürdigen Punkte* . . . to illustrate the theorem of Feuerbach. Note that three of the famous nine points, namely, the midpoints of the segments of the altitudes from the orthocenter to the vertices of the triangle, are not named on this diagram. [New York Public Library]

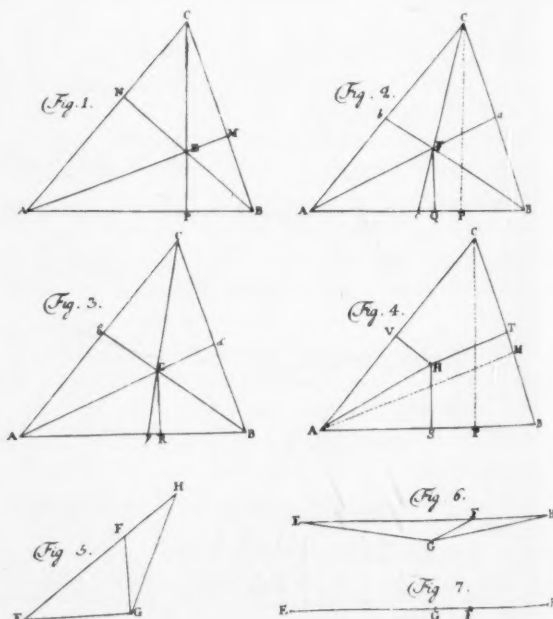
As the time passes, one can read the gradually growing pride and joy of the father in the son's accomplishments. He writes of the little book that Karl published in 1822 and asks a dear friend to do what she can to bring the book to the attention of influential people in Bavaria. The Feuerbachs were, after all, not native Bavarians; and moreover they were Protestants in a predominantly Catholic state. For these reasons the father feared that the son might encounter some difficulty in finding a place in the academic profession. When the son was appointed professor of mathematics at the Gymnasium at Erlangen everything seemed to be going well.

And then very suddenly, completely without warning and in a most humiliating manner, the father's pride, ambitions, and joy in the son Karl were shattered by a devastating blow. One day, as Karl was walking to school, he was arrested on the street. He was one of a group of 20 young men who were rounded up and later imprisoned in the New Tower in Munich. The men were arrested because of the political nature of the activities of an organization to which they had belonged as undergraduates. Karl had been known as a gay and carefree student in the early days of his university career. He had incurred debts, and he was at times impetuous and unconventional. However, between the lines of his father's letters, one can

read the thought that the incident may have been instigated by the father's political enemies.

In a long letter of 1 July 1827, the father pours out the anguish in his heart to a very dear personal friend. He tells how the weeks and months were allowed to drag on without action and that Karl was not allowed to receive letters or visitors. Karl became obsessed by the idea that only his death could free his 19 companions. He made two separate attempts at suicide. One evening he was found unconscious from loss of blood after having cut the veins in his feet. He was transferred to a hospital and then made a second attempt at suicide by jumping out a window. He was saved from death by landing in a deep snow bank but was permanently crippled as a result of the accident. The father writes bitterly of the fact that he was not more closely guarded, particularly since he had been declared on the verge of a mental breakdown when he was arrested. A short time later, Karl was paroled in the custody of his former teacher in Munich, Friedrich Thiersch (10), a close friend of the Feuerbach family. One of the 20 young men died while in prison. Finally, after 14 months, a trial was held, the men were vindicated, released, and allowed to resume their normal activities.

For about a year Karl seemed to want nothing



Diagrams used to illustrate Euler's article "Solutio Facilis Problematum Quorundam Geometricorum Difficillimorum." In these diagrams, the point E is the orthocenter of triangle ABC ; F the median point; G the center; and H the circumcenter. In Figs. 5 and 6 the line EFH is the Euler line of the triangle. [Zentralbibliothek, Zurich]



Karl Wilhelm Feuerbach. Published for the first time in *Genie und Krankheit* by Theodor Spoerri. [New York Academy of Medicine]

more than the companionship of his brothers and sisters, the comfort of his father's home at Ansbach, and the peace and quiet that would allow him to complete some mathematical research on which he had been working while he was in prison in Munich. It is doubtful that this piece of work could have had any greater compliment than the critical analysis to which it was subjected by Cantor in his article in the *Sitzungsberichte der Heidelberg Akademie der Wissenschaften* (8). In a final summary Cantor says that Feuerbach in this work proved himself to be an independent codiscoverer with Mobius of the theory of the homogeneous coordinates of a point in space.

Feuerbach's development of the theory of homogeneous coordinates is his second and last study. It is contained in three separate units. First there was a brief notice in Oken's *Isis* (11) written from Ansbach and dated 22 October 1826 under the heading "Einleitung zu dem Werke Analysis der dreyeckigen Pyramide durch die Methode der Coordinaten und Projectionen. Ein Beytrag zu der analytischen Geometrie von Dr. Karl Wilhelm Feuerbach, Prof. d. Math." (Introduction to the analysis of the triangular pyramid, by means of the methods of coordinates and projections. A study in analytic geometry). In this brief notice, Feuerbach gives a summary of his results, lists references, and says that he hopes to find a publisher for the entire work. The following year, 1827, the material was published in a 48-page book-

let at Nuremberg under the title *Grundriss zu analytischen Untersuchungen der dreyeckigen Pyramide* (Foundations of the analytic theory of the triangular pyramid). The third unit in this study is an unpublished manuscript in Feuerbach's handwriting, dated 7 July 1826—a manuscript that is discussed at great length by Cantor (8). However, Feuerbach's work on the triangular pyramid did not capture the imagination, as did his earlier publication *Eigenschaften einiger merkwürdigen Punkte*. . . . Many years after his death an effort was made to find a publisher for his manuscript of 1826, but these efforts were unsuccessful. In passing it is worthy of note that Feuerbach's *Grundriss* . . . , published at Nuremberg, and Mobius' *Der barycentrische Calcul*, published at Leipzig, both bear the date 1827.

When the young men who were arrested with Feuerbach had finally been released from prison, King Maximilian Joseph took great pains to help them return to a normal life. Feuerbach was appointed professor of mathematics at the Gymnasium at Hof. But at Hof Feuerbach was far from happy. Apparently he found no substitute at Hof for the companionship of his brothers and sisters, for the vivid personalities in his father's circle of friends, and for the gay university life at Erlangen. Before long he suffered such a severe relapse in his illness that he was forced to give up his teach-



A caricature of Karl Wilhelm Feuerbach. Published for the first time in *Genie und Krankheit* by Theodor Spoerri. [New York Academy of Medicine]

ing. Two of his brothers, Eduard and Ludwig, brought him back from Hof to Erlangen for medical treatment. By 1828 he had recovered sufficiently to resume teaching at the Gymnasium at Erlangen. But one day he appeared in class with a drawn sword and threatened to cut off the head of every student in the class who could not solve the equations he had written on the blackboard. After this episode he was permanently retired. Gradually he withdrew more and more from reality. He allowed his hair, beard, and nails to grow long; he would stare at occasional visitors without any sign of emotion; and his conversation consisted only of low mumbled tones without meaning or expression. And then there is no further word about Karl, not even in his father's letters. His father ends a letter of 6 July 1829, from Ansbach to the son Friedrich in Erlangen, with the sentence "Stay well—you and Eduard and Ludwig—and let me hear from you soon." Karl lived in retirement in Erlangen for 6 years and then died quietly on 12 March 1834.

Biographers of the Feuerbach family have been unexpectedly generous in granting space to Karl and his accomplishments in mathematics (12). But there is little about him in books on mathematics beyond the afore-mentioned article by Cantor (8) and practically nothing about him in any English language source. I can think of no more appropriate ending for this article than a very liberal interpretation of part of a letter that was written by Karl while he was imprisoned in the New Tower in Munich:

I will step lightly on my tiptoes, softly, slowly, and quietly, as is customary among ghosts, and then I will wriggle through the secret little knot-hole I have found in the oaken door of my cell. I will go right up to the attic and find my way there through the things that are covered up and stored away, and then slip out to freedom through a crack under the eaves. I will take a long deep breath, and then soar up and up, hither and yon, and I won't stop until I reach the benevolent moon. Then I will sit down on the very tip of the left horn of the moon, and sing a song of farewell to the earth and my beloved brothers and sisters.

I will tarry a while and wait patiently for the great comet that is supposed to appear in 1825, and I hope to beg for a tiny spot in the dust of the comet's trail that shall be mine and mine alone. And then with full sails, I will fly away over all the worlds.

References and Notes

1. Material for this article was generously placed at my disposal by the following: the Hauptstaatsarchiv and the Bayerische Staatsbibliothek at Munich; the Gymnasium Fridericianum in Erlangen; the library at the University of Heidelberg; the University of Freiburg (Br.); the Zentralbibliothek at Zurich; the Bibliothèque Nationale in Paris; the New York Academy of Medicine; and the New York Public Library. I also wish to express my gratitude to J. J. Burckhardt of the University of Zurich for his help in locating references to the work of Euler in original copies of *Novi Commentarii Academiae Scientiarum Imperialis Petropolitanae* (Petropoli) and *Nova Acta Academiae Scientiarum Imperialis Petropolitanae* (Petropoli).
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The work of science is to substitute facts for appearances, and demonstrations for impressions.—JOHN RUSKIN.

Lettuce Industry of the Salinas Valley

PAUL F. GRIFFIN and C. LANGDON WHITE

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SELDOME in continental United States does a single valley produce an overwhelming proportion of any food crop consumed by a majority of the nation's inhabitants. Yet the tiny Salinas Valley, which lies far from the great eastern urban and industrial markets and, hence, must ship its product under refrigeration and costly transportation over several thousand miles, supplies 45 to 50 percent of the national commercial head-lettuce crop (1). This fact is impressive, important, and significant. It is the purpose of this article, therefore, to point out how the industry developed historically and to present the geographic and economic conditions that enable it to monopolize production during 8 months of the year (from April through November).

The fact that the Salinas Valley has become the great lettuce-producing area that it is derives largely from the suitability of the soil and climate to the crop. But it was primarily a matter of accidental timing of several events, a coincidence of conditions all favorable to the introduction and expansion of lettuce in the valley, that caused the crop to develop as it did. The increasing demand in the East for western lettuce and the search for new irrigable lettuce land came at a time when Salinas Valley farmers were beginning to find themselves without a satisfactory crop. The search for new land was accelerated by the gradual disappearance of the Los Angeles area as a factor in lettuce production for eastern markets. The encroachment of city population on the lettuce lands of that district eventually made Los Angeles County a lettuce-deficient, rather than a surplus, area (2, p. 203). This event removed the principal California source of lettuce for spring, summer, and fall consumption. With Imperial Valley growers and shippers, who supplied the winter crop,

idle during the 9 months when the desert was too hot to produce lettuce and, with Los Angeles County supplying less and less of this crop for eastern markets, those interested in commercial production were seeking new areas for lettuce growth. This was happening at the very time that sugar beets, which had been produced in the Salinas Valley for more than two decades, were beginning to return poor yields both in tonnage and in value. Since both crops utilize much field labor, the shift from sugar beets to lettuce was not difficult. Moreover, it was discovered that the Salinas Valley, with some 20,000 acres of irrigated and irrigable land, afforded an extremely favorable combination of physical and economic conditions for this crop. Particularly favorable was the valley's location close to the coast, which gave it moderate summer temperatures—an important factor in the crop's growth at this season (Fig. 1).

Settlement of the valley. One of the earliest descriptions of the natural landscape of this area is embodied in a letter to the King of Spain, dated 23 May 1603, reporting the results of an exploratory trip along the coast of California by Don Luis de Velasco (3).

For more than 150 years after the arrival of Velasco, the new country was the scene of only an occasional expedition of exploration and adventure, but near the close of the 18th century the Spanish established a number of missions, presidios, and pueblos along the coast between San Diego and San Francisco. Farming was practiced to a small extent in the vicinity of these establishments, but the first important development of agriculture took place shortly after the beginning of the 19th century on the large ranchos, or land grants, managed by the native-born or naturalized owners, who raised some grain and grazed their

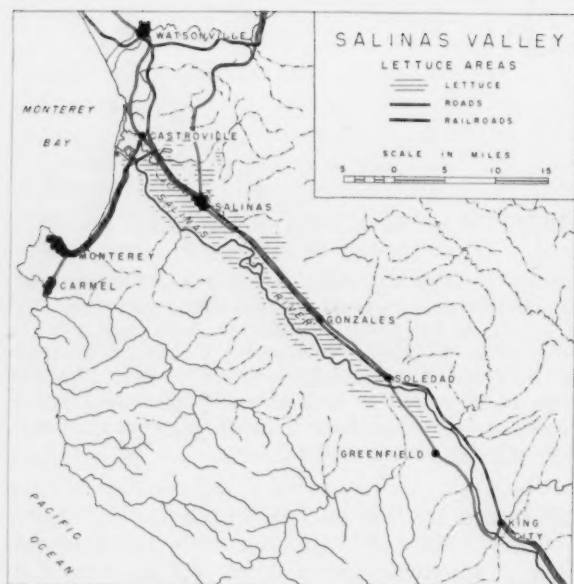


Fig. 1. The Salinas Valley grows 45 to 50 percent of the nation's total commercial lettuce crop. Possibly nowhere else in the United States does so small an agricultural area produce so large a percentage of a widely consumed commercial crop.

increasing herds of cattle and horses over the unfenced range.

With the establishment of Mexican independence in 1821 the Republic passed more lenient regulations regarding trade and settlement, and a gradually increasing number of trappers, settlers, and other pioneers moved into the region. The great tide of overland in-migration and the period of more extensive agricultural progress did not take place, however, until after the close of the Mexican War and the acquisition of the territory by the United States.

According to the United States census for 1880, the total area of Monterey County was 2,131,200 acres. Each of the county's 834 farms averaged slightly less than 400 acres in size. Of this acreage 83.7 percent was classed as improved land. The population, all rural, was reported as 11,302. The number of farms and the rural population nearly doubled during the decade ending in 1890, while the size of the farms increased nearly 50 percent. In recent years a transition has occurred from the extensive system of agriculture to a more intensive one, with a resulting greater return per acre.

Physical setting. The Salinas Valley, largest of the intermontane valleys of the Coast Range, is a broad fertile area 6 to 15 miles wide. Its physical conditions are especially favorable for the production of iceberg lettuce. The prevalence of summer

fogs, which maintain a lower and more even temperature during the high sun period, is the most significant factor. There is a definite relationship between temperature and the growing of this crop. Table 1 shows the interrelationship between lettuce shipments and, therefore, production and temperature.

Lettuce is extremely perishable and is affected, probably more than any other single crop, by changing weather conditions. Continuous high temperatures are ruinous. A few hours of damp weather followed by a few hours of hot weather will cause the lettuce to slime and will cook the leaves.

The relatively low annual rainfall and the long dry summer would limit the number of crops that could be grown in the valley if water for irrigation were not available. Since surface streams provide only a limited quantity of water for irrigation, reliance is mainly on ground water. Most of this is obtained at comparatively shallow depths—seldom more than 125 feet. The water is of high quality, and there appears to be no intrusion of salt water from the ocean to the pumping strata.

The soils range from clay loams to sandy loams. All are fairly low in organic content, a condition that necessitates the practice of green manuring. Several crops of lettuce cannot be grown properly without at least one of green manure intervening, particularly if animal manure is not available. Large quantities of fertilizer are usually placed on the land before planting. Also soluble fertilizer is frequently applied in the irrigation water.

The land on which the lettuce is grown is flat; this favors irrigation and field operations. Such land is at a premium, selling for around \$1500

Table 1. Relationship of average monthly temperatures to average monthly shipments of lettuce at Salinas. (Compiled from *Daily Market Reports* issued in Salinas, Calif., 1953.)

Month of shipment	Average temperature (°F)	Average shipments (carloads)
January	49.0	0
February	51.2	0
March	53.5	18
April	55.7	2678
May	58.6	7014
June	60.8	5805
July	61.8	5341
August	62.0	5887
September	62.0	5575
October	58.9	5390
November	54.2	1562
December	50.3	236



Fig. 2. Rows of lettuce in the Salinas Valley. Here farming is both a science and an art. [Courtesy Jack Bias, Grower-Shipper Vegetable Association]

per acre and at times having brought as much as \$2500.

Production of lettuce. The first commercial planting of lettuce in the Salinas Valley occurred in 1920. Since then the production of the valley has risen until the area now supplies about half of the nation's lettuce and monopolizes the off-season market (2, p. 204).

In the initial years of commercial production, the first plantings were generally on less than 10 acres. This acreage, however, was too small to be profitable. Hence the need arose for larger farms in order to meet the national demand. Although lettuce is grown in spring, summer, and fall in the valley, a given field never produces more than one crop of lettuce and another of sugar beets, carrots, or broccoli.

In lettuce growing the fields require much preparation prior to planting. The land must be flat and the beds must be uniform in height, so that the irrigation water can be applied without flooding certain areas and leaving others high and dry. In general, the soil should be plowed and then disked and harrowed to a fine, mellow condition before the seedbeds are made. Almost all the lettuce in the Salinas Valley is planted on raised beds,

which facilitates irrigation and drainage (Fig. 2). The general custom is to grow two rows of lettuce on a bed. The common spacing is 40 inches from center to center of the beds with the two rows about 14 inches apart on the ridge.

From planting to harvesting, lettuce requires 65 days during the warm season to 120 days or more during the coldest season. The annual lettuce season in the Salinas area is conveniently broken into the following planting periods: (i) early spring, planted in late November, December, and January for harvest to May 1; (ii) late spring, planted during February for harvesting to July 1; (iii) summer, acreage planted during the period 1 March–1 June, for harvest during the period 1 July–1 September; (iv) fall, acreage planted between 1 June and 1 September, for harvest after 1 September.

Lettuce should be thinned before the plants begin to crowd. In warm weather this time may be 3 weeks after planting; in cool weather it may be as long as 8 weeks. Laborers, largely Mexican, using special short-handled hoes, block out the plants 12 to 14 inches apart in the row, one to a place; those not true to type are removed (Fig. 3). If plants are too close together, the size of the



Fig. 3. Lettuce must be thinned before the plants begin to crowd. Lettuce plants require plenty of room; if they are spaced too close together, the size of the head is reduced and maturity is delayed. Both blocking and thinning are still largely hand operations. [Courtesy California Agricultural Extension Service]

head is reduced, with a delay in maturity and reduction in size resulting. Blocking of the lettuce by machine with subsequent hand-thinning of the remaining clumps of plants is being more extensively practiced. Thinning is important.

The details of irrigation vary considerably and at different seasons. Small plants need much less water than large ones do. Less water is required when the weather is cool and humid than when it is hot, dry, and windy. The frequency of irrigation also depends on the water-holding capacity of the soil. As a rule, more irrigations are needed on light, sandy soils than on silt or clay-loam soils. Judging from recent irrigation experiments under the climatic conditions prevailing in the Salinas Valley, one irrigation about 30 days after thinning produces as much as more frequent applications (Fig. 4). A crop of lettuce needs not more than 4 acre-inches of water to reach maturity. Actually, however, because of waste in applying the water, greater quantities are employed.

If weeds are abundant, cultivation is practiced before thinning. Often cultivation is needed to open the furrow and to replace the soil around the young plants after thinning or, later, to destroy weeds that rob the soil of moisture and soil nutrients. Beyond this point it is seldom necessary or even beneficial.

It is significant indeed that many grower-shippers find it pays to hire expert field representatives

who daily observe the lettuce and decide when it should be irrigated, fertilized, and harvested.

The field labor consists mostly of Mexicans who are hired as hands for a period of approximately 10 months. They perform all operations from cultivating to harvesting. General farm labor is mainly local and native born.

Harvesting the lettuce. For many years the harvesting was done by hand with a gang of men moving down the rows, cutting the matured heads from the two rows adjacent to a furrow and tossing them onto trucks or trailers. In the larger lettuce-growing communities mechanical loaders were used. The lettuce was then delivered to the packing sheds, placed in standard California wooden crates, iced and loaded into refrigerator cars. This "top-icing" was the shippers' only method of keeping the lettuce alive and fresh during transit. This method of "top-icing" had several disadvantages: the ice frequently bruised the heads and sometimes even froze them, and the melting ice with the excessive moisture tended to slime the lettuce.

In 1946 a revolutionary process of field packing and vacuum precooling got underway, thereby eliminating the "icing" operation in the packing shed. Now the heads are packed in cardboard cartons in the field. The average weight of these cartons is 40 pounds and each contains 2 dozen heads. The new method involves three types of handling—ground-pack, machine-pack, and trailer-pack. In the ground-pack method a truck carrying a carton-making unit precedes the crew through the area being harvested. Cutter-trimmers cut the mature lettuce, trim off the defective leaves, and place the heads back on the planting bed. Packers then transfer the trimmed heads from the beds to the cartons, which are stapled and placed on a truck.

In the machine-pack method (Fig. 5) every operation takes place on the machine. Cutter-trimmers precede the machine that passes over the trimmed heads. Men then transfer the trimmed heads to packing tables on the machine, and the closed, stapled cartons are conveyed to a truck that moves through the field.

The trailer-pack method is similar to the machine method except that it uses a smaller crew. The packers, carton makers, and closer ride on the trailer, while pickup men transfer the trimmed heads to the packing tables that extend from the sides of the trailer. Packers then place the lettuce in cartons, which go forward by gravity conveyor to the truck. Studies show that the machine-pack method is the most economical and results in sizable reductions in both packing and shipping costs.

In all three methods the packed lettuce is taken to large vacuum tubes, in which the air is extracted



Fig. 4. Lettuce needs a considerable, although not excessive, amount of water during its period of growth. The root system is relatively shallow and if the high ridges are permitted to dry out, the plants suffer. One irrigation of about 4-acre inches applied about a month after thinning (as illustrated here) produces as much lettuce as more frequent applications. [Courtesy California Agricultural Extension Service]

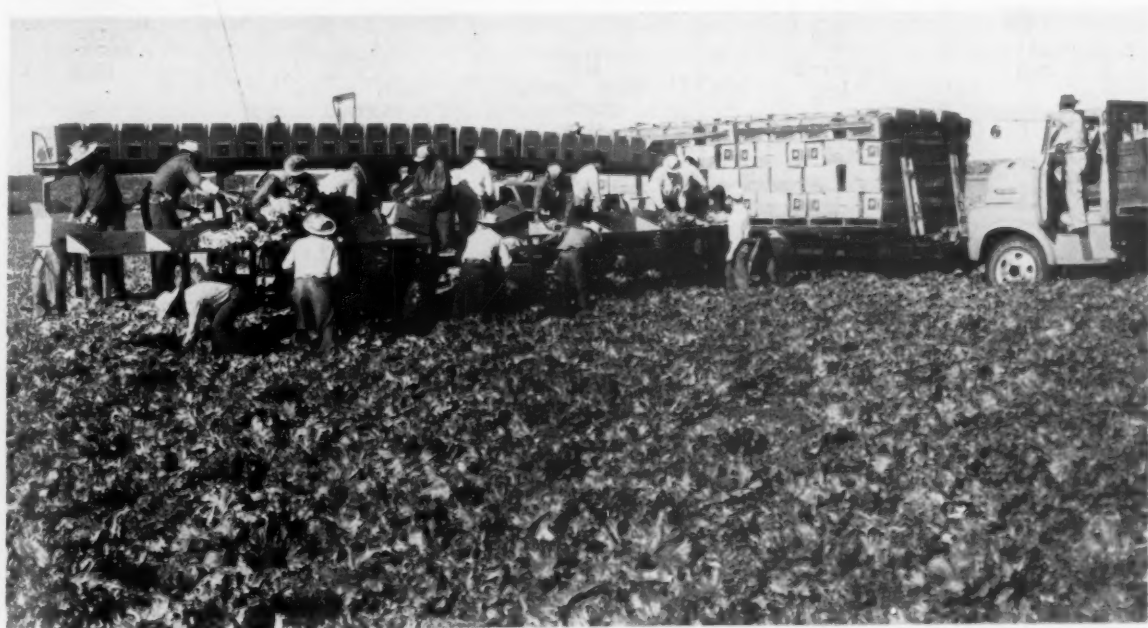


Fig. 5. Harvesting lettuce in the field. The heads are placed in cartons of the dry-pack machine and then hauled to the vacuum-cooling plant by truck. [Courtesy of Cochran Equipment Company]

Table 2. Monthly Salinas-Watsonville lettuce shipments and estimated ice-pack and dry-pack with percentage of dry-pack. Compiled from *Daily Market Reports* issued in Salinas, Calif. Figures in the last column are based on 1954 total carlot shipments and show percentage of dry-pack for that year.

Month	Salinas-Watsonville carlot shipments, 1953	Ice-pack 1953	Dry-pack 1953	% of dry-pack, 1953	% of dry-pack, 1954
April	2678	1949	729	27	72
May	7014	4565	2449	35	72
June	5805	4127	1678	29	67
July	5341	3696	1645	31	72
August	5887	3546	2341	40	79
September	5575	2893	2682	48	82
October	5390	2626	2764	51	85
November	1562	683	879	56	75

and the exterior moisture from the lettuce is evaporated, causing a reduction in temperature. The lettuce is held in the tube for 25 minutes at a temperature of 33°F, every part of the head being affected at the same time. This compares with the old "top-icing" method which required from 24 to 36 hours. The advantages of the dry-pack method are reported to be no water soaking, no

discoloration or ice bruising, and a fresher, greener, and crisper head. Also the container is easier to handle than the conventional wooden crate, and retailer action has been very favorable. The elimination of the top-ice results in a saving. It is said that two cardboard one-half crates effect a saving over the conventional wooden crate of 22½ to 24½ cents.

Today there are nine steam and ammonia vacuum cooling plants in the area, representing a combined value in excess of \$3 million. Dry-pack shipments have increased greatly during the past several years (Table 2).

Problems facing the lettuce growers in the valley. The perishable nature of lettuce, the great distance of the Salinas Valley from the nation's principal markets, and the inability of growers or shippers to control either production or flow to the market, all have operated to make lettuce growing and shipping a highly speculative industry, characterized by a rapid turnover of firms and great variability of returns (2, p. 205). In 1949 most of the lettuce was shipped to middle-western and eastern markets (Fig. 6). In a recent year shipments from Salinas went to 46 of the 48 states.

Lettuce is received in the eastern markets 6 to 10 days after it leaves Salinas. Nearby markets are

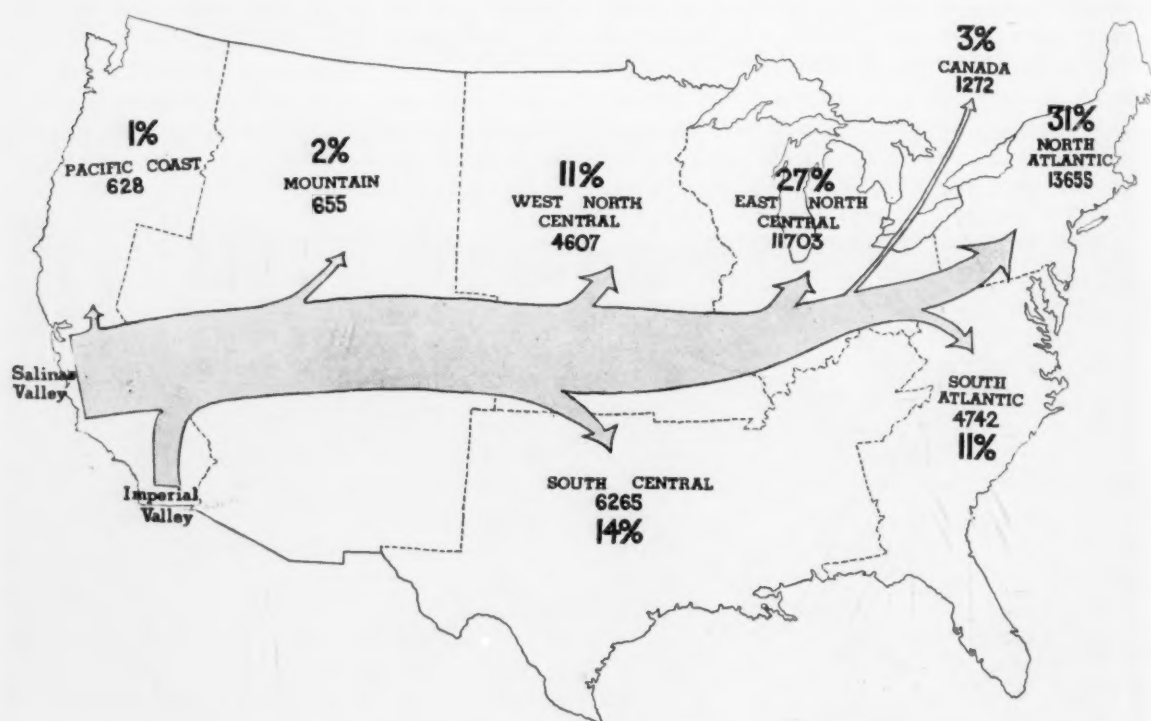


Fig. 6. California lettuce shipments to major United States markets (carlot and percentage unloads). Note that the two largest markets are the North Atlantic and East North Central areas. [After Robert C. Rock; map drawn by Eileen Conaghan]

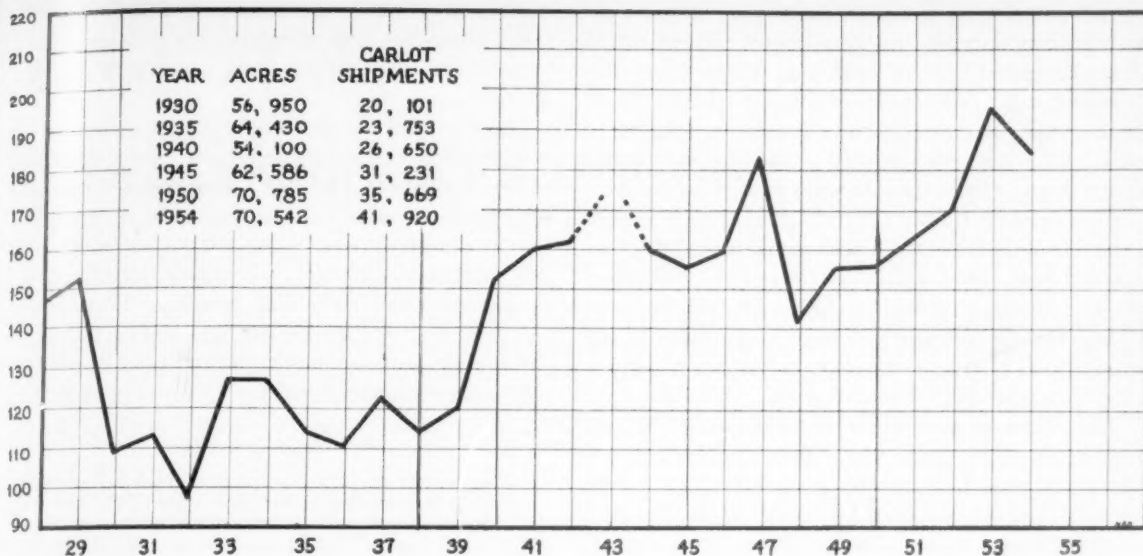


Fig. 7. Acres planted and crates per acre shipped from the Salinas-Watsonville district 1928-54. The figures at the left indicate crates per acre. [After A. A. Tavernetti; chart drawn by Nan Davis]

reached by truck; the equivalent of 600 cars monthly moves in this manner to the San Francisco and Los Angeles markets alone.

Lettuce prices are subject to such violent daily fluctuations that cars enroute frequently suffer from lower market price. Hence, it is not certain that cars in transit will bring anything like the amount of their f.o.b. prices in Salinas, and there is ample opportunity for forecasters and speculators to gamble on these short-term market changes. The gamble is further complicated by the fact that prices in the various eastern markets do not necessarily move together, so that a glutted market in, say, New York, and a firm one in Chicago may exist on the same day. Everything affects the market. In a single day, prices may vary widely. When speculations are made, they are obviously made on crops still in the ground. The weather meanwhile can either hold back or push ahead a harvest enough to dominate the price. In fact, weather can result in the entire valley's crop coming to head at one time, thereby glutting the market.

Despite the dominance of the Salinas Valley, the market price of lettuce is largely affected by production in other areas of the country. Arizona, Texas, Colorado, Idaho, Oregon, and Washington also ship at various times throughout the Salinas season. Particularly from mid-June through September, Salinas Valley growers meet worthy competition from eastern market gardeners growing for local markets in New York and New Jersey. During the past few years eastern competition has become intensified as the East has developed lettuce strains

more frost resistant and similar to the type with which the West formerly usurped the market. In addition, eastern production costs have been lowered as the lettuce enterprise has grown and as more machinery has been used. Beginning in 1938, New York growers improved cleaning, packing, and shipping methods to such an extent that the New York lettuce matched California lettuce in appearance when it was sold (4). Nonetheless, the Salinas area, because it can grow and ship lettuce continuously during an 8-month period, is able to withstand competition from other areas unusually well. No other area is so favored in this respect. In eastern growing districts diseases are prevalent after midsummer; accordingly this forestalls major production in late summer, except during occasional favorable years.

Shippers have had little success in their attempts to adjust the supply of lettuce to price and to prevent disastrous oversupplies from reaching the market. The perishability of the crop, the irregularity of the price variations, the uncertainty of yields, the wide shipping business, all have operated to prevent stabilization of the industry. Once the crop is planted, the growers can exercise little control over the time of harvest and can predict the date of maturity only within rather wide limits. Weather conditions during the growing season and plant diseases that cannot be completely controlled affect both the time of maturity and of planting as well as the character of the yield. A late spring may delay planting of the spring crop or retard the growth of the plant once it is in the ground. A spell

of hot weather, on the other hand, may bring a field to maturity a week or two before the expected date. Excessive heat or cold may destroy the crop entirely; cold, wet weather may result in small heads and poor yield. Thus lettuce is subject to most of the hazards peculiar to farming that make difficult any attempt to stabilize prices (2, p. 230).

Conclusions. Lettuce is unique in that it is consumed only in fresh form, and growers and shippers are not concerned with other types of utilization, such as canning or drying. Although this fact simplifies the disposition problem, it also limits the alternatives that growers may select after the lettuce is produced.

The marked expansion of commercial lettuce production and shipment is reflected in a corresponding growth in the nation's lettuce consumption—a part of the trend evident in this country during the past several decades (Fig. 7). There has been a phenomenal growth in production and consumption of fresh, canned, and frozen vegetables and fruits in recent years.

The trend of per-capita lettuce consumption generally follows the trend of national income. All

studies, in which lettuce was considered as a separate commodity, indicate that usually as consumers' incomes increase, their lettuce consumption also increases.

Growers and shippers, as well as consumers, are interested in the probable future course of lettuce prices. In general, lettuce farm prices during the past three decades did not rise so high nor fall so low as did the prices of most truck crops. Clearly, the vegetable industry, of which lettuce is the major representative, will continue to dominate the economic life of the Salinas Valley as long as the market remains large, the price relatively low, and competition with eastern growers not too keen.

References and Notes

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Science is rapidly destroying, or at least overriding and overruling, the old boundaries. We are fast becoming neighbors of one another with far-reaching implications for old concepts and practices like war, race, nationality and the like. Neighborliness, the "good neighbor," are not only ethical concepts but are rapidly becoming economic, political and international concepts and standards of human behavior which we violate at our peril. This may be a hard saying, but war is the hardest of all teachers and its nameless sufferings and sacrifices in our generation are at last driving home to us the inner meaning of what religion has always taught us and science is now rediscovering for us.—JAN CHRISTIAAN SMUTS.

Medals of the Royal Society of London

ERWIN F. LANGE AND RAY F. BUYERS

Mr. Lange, professor of general science at Portland State College of the Oregon State System of Higher Education, is the author of "Thomas J. Howell, Pioneer Oregon Botanist" that appeared in the October 1953 issue of The Scientific Monthly. Mr. Buyers is principal of the Concord Elementary School, just south of Portland; his hobby is coin collecting and the history of coins and medals.

CIVILIZED MAN has ever been ready to recognize outstanding achievement of his fellowman. This has been true in science as well as in the literary, artistic, political, athletic, and military pursuits. During the ages such recognition has taken many forms, the most common being the erection of busts and statues, commemoration through special issues of coins and postage stamps, and the award of prizes and medals.

The practice of placing the likeness of an outstanding scientist on a coin or medal dates back to at least A.D. 100 when the figure of Pythagoras, the great Greek mathematician and philosopher, appeared on a coin of the island of Samos. In the period following the Renaissance a number of special medals were struck honoring great scientists. The periodic awarding of medals and prizes is closely associated with the rise and development of scientific societies. In recent times the Nobel prize has been widely publicized and is particularly well known. However, the medals and the accompanying prizes of the Royal Society of London, chartered in 1662, have had an important influence on the development of modern science both in America and Europe. The achievements of the recipients of the medals of the Royal Society constitute, in effect, a fascinating story of modern science. Many American scientists have been recipients of these honors and one, Thomas Hunt Morgan, America's famed geneticist, was awarded two of these medals. This article summarizes the historical background of the medals awarded by the Royal Society of London for outstanding achievement in the several natural sciences.

Copley Medal. The oldest and most prized medal of the Royal Society was established to stimulate scientific research and resulted from the legacy of Sir Godfrey Copley, Bart. F.R.S. Copley had been a fellow of the society since 1691 and, in a will dated 1704 and proved in the court in 1709, left

£100 in trust for the Royal Society "to be laid out in experiments, or otherwise, for the benefit thereof, as they shall direct and appoint." During the early years the interest of the fund was paid to the curator of the society for performing scientific experiments before the membership. In 1736, however, in order to have the fund exert a greater influence on the development of science, a suggestion was proposed that, instead of the annual experiment,

... a medal or other honorary prize should be bestowed on the person whose experiment should be best approved, by which means ... a laudable emulation might be excited among men of genius to try their invention, who, in all probability may never be moved for the sake of lucre.

It was then resolved to award annually a gold medal to the author of important scientific discovery or experimentation. The weight of the medal was fixed at 1 oz 2 dwt of fine gold and valued at £5. The portrait of Sir Godfrey was placed on the obverse and the arms of the society on the reverse of the medal.

In 1831 the society resolved that the Copley medal should be awarded to

... the living author of such philosophical research, either published or communicated to the Society, as may appear to the Council to be deserving of that honor.

The Copley family increased the fund in 1881 so that a gift of £50 could be awarded to the recipient of the Copley medal. However, as interest rates dwindled the fund did not provide enough to make such a large award, so that in recent years the prize has been £35.

The list of more than 200 recipients of the Copley medal and prize is composed of a brilliant array of scientific talent representing all the major branches of scientific interest. American scientists

have not been neglected. Among the American-born men of science who have received the highest honor that the Royal Society can bestow are such names as Benjamin Franklin, Benjamin Thompson, better known as Count Rumford, Josiah Willard Gibbs, James Dwight Dana, George Ellery Hale, Theobald Smith, and Thomas Hunt Morgan. European-born scientists who spent some or much of their time in the United States and were recognized as winners include Joseph Priestley, Louis Agassiz, Albert Michelson, Albert Einstein, and Oswald T. Avery.

Rumford medal. One of the most interesting of scientific personalities to emerge from the American Colonies was Benjamin Thompson, who acquired the titles Lieutenant-General Sir Benjamin Thompson, Count Rumford, F.R.S.

Benjamin Thompson was born in Woburn, Massachusetts, on 26 March 1753, and during his childhood showed considerable interest in the study of science. Early in life his marriage to a rich widow gave him time and opportunity to pursue scientific study and philosophic writings. However, during the early part of the Revolutionary War he favored the Tory cause and went to England in 1776, without his wife, to spend a life in military, scientific, and political pursuits in foreign countries.

He gained favor in England and during the Revolutionary War he rose to the rank of lieutenant colonel against his former countrymen. He was knighted by George III and was attracted by the Elector of Bavaria, in whose service he spent many years working on social reforms and had opportunity to carry on scientific investigations. At a time when heat, light, and electricity were still thought of as "subtle matter" and referred to as "imponderables," Thompson's famous experiment of producing indefinite quantities of heat by friction in boring a cannon without the cannon losing weight was decisive in taking heat, then known as igneous fluid or caloric, out of the class of the "imponderables." He showed that heat results from motion or vibration among the particles of "ponderable" matter.

The Elector of Bavaria made Thompson a count of the Holy Roman Empire, and on that occasion he chose the title Count Rumford, in honor of his former wife's home village in Connecticut.

Thompson's association with the Royal Society extended over a 35-year period. In 1779 he was first elected to the society. In 1792 he was winner of the Copley medal. The results of his research were published in the *Philosophical Transactions*.

In a letter dated 12 July 1796, Count Rumford notified Sir Joseph Banks, then president of the society, that he had transferred to the society £1000

stock, the interest of which was to be awarded every second year as a premium to the author of the most important discovery or useful improvement in light or heat announced during the preceding 2 years in any part of Europe. Discoveries that tended to promote the welfare of man were to receive special consideration. The premium was to be in the form of a gold and silver medal, the value of 2 years' interest on the stock. In case the council felt that a worthy recipient was not available, the interest was to be added to the principal sum. This occurred frequently during the early years, and during the period 1818-32 the medals were awarded only in 1824. After the first award, Thompson clarified somewhat the purposes for which the medals might be given. Awards could be made for new theories of fire, heat, light, and color and for discoveries in chemistry and optics, but he particularly encouraged the consideration of practical improvement that would increase enjoyments and comforts of life for the "lower and more numerous classes of society." The medals were first awarded in 1800, and Thompson was the first worthy recipient.

Although expatriated from the United States, Count Rumford always had a kindly feeling toward his home land. In 1796 he also established a Rumford medal in the new world with a fund of \$5000 given to the American Academy of Arts and Science, the interest of which was to be awarded as a premium every second year to the author of the most important discovery or useful improvement announced on heat or light on the continent of America or any of the American islands during the previous 2 years. The stipulations for the two Rumford medals were worded almost identically.

In 1800 Rumford was instrumental in making science more popular in England by assisting in the founding of the Royal Institution, by which means the public was to be able to hear at lectures the discoveries of science. Rumford's influence in securing Sir Humphry Davy as lecturer for the Royal Institution assured the success of this new organization.

In his later years Rumford was for a short time married to the wealthy widow of Antoine Lavoisier. He died 21 August 1814. Rumford's influence on science continues to this day. To Harvard University he left a large bequest for the founding of the Rumford Professorship of the Physical and Mathematical Sciences. He gave his library on military science to the United States Military Academy. The Royal Institution and the two Rumford medals are living memorials to this American-born man of science.

Royal medals. The national value of the scien-

tific achievements of the Royal Society was recognized by George IV when in 1825 he wrote to Sir Humphry Davy, then president, a proposal to establish two gold medals to encourage scientific discoveries. On 15 December 1825 the two Royal medals, valued at 50 guineas each were established to be awarded for the most important discovery reported to the Royal Society in "the year preceding the day of their award," which was soon changed to "within five years preceding the day of such award."

William IV continued the grant for the medals in 1833 under the condition "that the subject-matter of the inquiry should be previously settled and propounded by the Council three years preceding the day of award."

Grants for the annual awarding of the Royal medals were continued by Queen Victoria in 1838. During Victoria's reign a number of modifications were made in the conditions for the awards. The medals were to be given only for papers presented before the Royal Society and included in the *Transactions*. The council proposed a triennial cycle of subject matter: astronomy and physiology; physics and geology or mineralogy; mathematics and chemistry. This was approved by Queen Victoria.

Later, in 1850, the following proposal was approved.

That the Royal Medals in each year should be awarded for the two most important contributions to the advancement of Natural Knowledge, published originally in Her Majesty's dominion within a period of not more than ten years, and not less than one year of the date of the award, subject, of course, to Her Majesty's approval. . . . That it is desirable that, in the award of the Royal Medals, one should be given in each year to each of the two great divisions of Natural Knowledge.

This proposal has been followed ever since in selecting the winners of the Royal medals.

The medals have been continued through grants made by each succeeding monarch to the British throne. Beginning with John Dalton in 1826, Britain's most illustrious scientific talent has been honored by the two gold medals awarded annually by the sovereign.

Davy medal. On 15 August 1815, the great English chemist Humphry Davy, who before reaching the age of 30 had isolated by electrolysis six alkaline and alkaline-earth metals, received a letter concerning the many dangerous and fatal explosions in the British coal mines. Being concerned, he immediately set out on a program of experimental investigation to find means whereby the miners might be protected from such fatal accidents. By

December of the same year the "wire-gauze safe-lamp" had been perfected. (The first safety lamp is still in the possession of the society.) In June 1816 a letter from Wallsend Colliery, Newcastle, announced that the new lamp had been in use "daily for every variety of explosive mixture for upward of three months." The coal-mine owners of Newcastle conveyed a vote of thanks to Davy, who refused to patent his new invention. The lamp continued to prove its value in saving the lives of miners, and on 25 September 1817, Sir Humphry was honored at a banquet, and as an expression of their gratitude the miners presented him with a gift of plate.

Davy's association with the society was outstanding. He served as both secretary and president. Three times he was awarded a medal of the society: the Copley medal in 1805, the Rumford medal in 1816, and the Royal medal in 1827. His contributions include 46 memoirs and lectures to the *Philosophical Transactions*.

Forty years after the death of Davy, the will of his younger brother, John Davy, bequeathed the service of plate to the Royal Society to be melted and sold in order to establish a medal to be awarded annually for the most important discovery in chemistry. More than 736 pounds was realized, of which 660 pounds was invested in railway stock, and the earnings were used to perpetuate the medal. Several years elapsed before the dies could be prepared, so the first medal was awarded in duplicate to Bunsen and Kirchhoff in 1877. Originally the medal was struck in gold, but owing to the decreasing income from the investment, a bronze medal has been awarded since 1935. The balance of the income is awarded to the recipient as a prize.

Such eminent American chemists as Theodore W. Richards, Gilbert N. Lewis, Arthur Noyes, Roger Adams, Harold Urey, and Linus Pauling are found among the more than 80 world-famous recipients of this important medal in chemistry.

Darwin medal. The Darwin medal resulted from the transfer of the remainder of the International Darwin Memorial Fund to the Royal Society in 1885 to be devoted to the promotion of biological study and research. The medal was to commemorate the work of Charles Darwin (1809-1882), a fellow of the Royal Society and winner of the Royal medal in 1853 and the Copley medal in 1864, and to honor workers in the field in which Darwin himself labored.

The medal, struck in silver and accompanied by a grant of £100, is awarded biennially with no distinction as to sex or nationality. The earnings of the fund have been such that a small balance



Copley medal
(diameter $2\frac{1}{4}$ in.)



Rumford medal
(diameter 3 in.)



Royal medal
(diameter 3 in.)



Davy medal
(diameter 3 in.)

Darwin medal
(diameter $2\frac{1}{4}$ in.)



Buchanan medal
(diameter $2\frac{1}{4}$ in.)



Sylvester medal
(diameter 3 in.)



Hughes medal
(diameter $2\frac{1}{4}$ in.)



[All photographs by courtesy
of the Royal Society]

usually remained after the awarding of the medal and the prize. Since 1910 this surplus has been devoted by council rule

... not to the provision of scholarship or medals, but to the furtherance of biological research in the Darwinian field, and that it be expended at the discretion of the Council on the advice of the Sectional Committee for Botany and Zoology meeting jointly.

Americans who have been recipients of this medal include Henry F. Osborn and Thomas Hunt Morgan.

Buchanan medal. The Buchanan medal was established in honor of Sir George Buchanan (1827-1895), F.R.S., a distinguished British physician. After his death in 1895 a committee collected £276 12s and turned this over to the Royal Society to award a gold medal every 5 years for

... distinguished service in Hygienic science or Practice, in the direction either of original research or of professional, administrative, or constructive work.

The balance of the earnings of the fund accompanies the medal as a money prize.

The subscribers of the fund awarded the first medal to Lady Buchanan. William C. Gorgas and Frederick F. Russell were American recipients of the medal.

Sylvester medal. Friends of J. J. Sylvester, F.R.S., and winner of the Copley medal in 1880, were interested in establishing a Sylvester memorial after his death in 1897. Consequently, an international committee collected almost £900 from interested people in all parts of the world. The fund was entrusted to the council of the Royal Society, and the earnings of the fund are used for the awarding of a bronze medal and prize triennially, without regard to nationality, for outstanding mathematical research.

Hughes medal. The establishment of the Hughes medal resulted from a bequest to the Royal Society in 1900 of £4000 by David Edward Hughes, who

had himself been a winner of a Royal medal in 1885. Hughes directed the council of the Royal Society to use the income from the fund to make an annual award of a prize or medal for the outstanding original discovery in physical science, particularly electricity or magnetism, or its application. The council directed the income to be used for the annual granting of a gold medal which does not exceed £20 in value together with a prize of the remainder of the income to "such persons as the President and Council may consider the most worthy recipients, without restriction of sex or nationality." The discovery or application must have been published not less than 1 year before the granting of the award. If in any year the council does not feel that a worthy recipient is available the medal is not awarded and the income is added to the fund. This occurred in 1924.

American workers have competed well for this honor. Among the winners are Alexander Graham Bell, Irving Langmuir, Robert Millikan, William D. Coolidge, Arthur Compton, Ernest O. Lawrence, and Enrico Fermi.

In 1900 the council adopted the following resolution and has printed it in each succeeding year-book since.

Every year the Council have to award several medals, including the Copley, Royal, Rumford, Davy, Darwin, Buchanan, Sylvester, and Hughes Medals, or some of these, and have been led by experience to the conclusion that it is neither to the advantage of the Society nor in the interests of the advancement of Natural Knowledge that this already long list of medals should in future be added to, and that, therefore, no further bequests to be awarded as prizes for past achievements should be accepted by the Society.

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The men of culture are those who have had a passion for diffusing, for making prevail for carrying from one end of society to the other, the best knowledge, the best ideas of their time: who have labored to divest knowledge of all that was harsh, uncouth, difficult, abstract, professional, exclusive; to humanize it, to make it efficient outside the clique of the cultivated and learned, yet still remaining the best knowledge and thought of the time, and a true source, therefore, of sweetness and light.—MATTHEW ARNOLD.

SCIENCE ON THE MARCH

INTERNATIONAL GEOPHYSICAL YEAR

TWICE within the past 75 years great international enterprises have been organized to make meteorologic, magnetic, and auroral observations in the north-polar region. The polar regions are of special importance for the study of weather, the earth's magnetism, and the aurora. They are the storm centers of the globe and, therefore, have a great influence on world weather; it is there that the disturbances in the earth's magnetism, known as *magnetic storms*, are most violent and that the most vivid and most frequent displays of the aurora are to be seen.

North-polar observatories. In 1879 the International Meteorological Committee appointed a special commission to organize temporary observatories in the north-polar region for 1 year, 1882-83, which is now known as the first International Polar Year. Many nations cooperated and the observations made at the temporary stations were coordinated with those made at permanent observatories in lower latitudes. Fifty years later a second International Polar Year was organized, and during 1932-33 an extensive program of observations was carried out at many temporary observatories in high latitudes as well as at permanent observatories.

The data collected during these two Polar Years provided much important information concerning the weather of the north-polar area and the variations in the earth's magnetic field at different latitudes during normal quiet periods and during magnetic storms. The magnetic data, in conjunction with the data from the permanent magnetic observatories, have provided a framework on which to base theories of magnetic storms and of the normal daily, seasonal, and long-period variations of the earth's magnetic field. By the time the second Polar Year was organized, the importance of the ionosphere (that is, the ionized region high up in the atmosphere) for radio communications had come to be realized. Radio waves below a certain critical frequency are reflected by the ionosphere and travel around the curved surface of the earth instead of escaping into space. The program of observations made during the second Polar Year was accordingly enlarged to include the investigation of the ionosphere by the use of radio.

Many of the terrestrial phenomena studied in the branch of science called *geophysics*—the physics of the earth—are associated in some way with the sun and with events on the sun. Consequently, they

have complex interrelationships, which, for the most part, are still little understood. The sun provides the energy involved in the circulation of the atmosphere and in the production of thunderstorms, cyclones, and hurricanes; in the maintenance of ocean currents; and in the production of magnetic storms and auroras. But the way in which the energy is delivered to the earth and the manner in which it is utilized are not at all clear.

Sunspots and their effects. The sun has a cycle of activity, with a period of about 11 years, during which the frequency of the appearance of sunspots increases from a minimum to a maximum and then dies away again. Closely correlated with the cycle of solar activity is the normal daily variation of the earth's magnetic field at any place. Magnetic storms are more frequent when sunspots are numerous, and a great magnetic storm often develops when a large sunspot is near the center of the sun's disk. But there may be a large spot on the sun without a magnetic storm occurring, and, on the other hand, a magnetic storm may develop when the sun is free from spots. Therefore, we cannot say that the sunspot causes the magnetic storm. A bright eruption or flare will often take place on the sun in the vicinity of a developing sunspot, and then there is a sudden blackout on all short-wave radio channels over the sunlit half of the globe. The most favorable wavelengths for long-range radio communication change with the seasons and throughout the sunspot cycle. The most intense displays of the aurora occur at the time of a great magnetic storm, and the frequency of the aurora fluctuates with the sunspot frequency.

In the past, the earth has experienced warm periods and ice ages. At present it seems to be in a period of warming, which is shown by the progressive shrinkage of glaciers in recent years, during which there has also been a progressive rise in the level of the Great Lakes in North America, increasing drouth in the southwestern states of the United States, and increasing rainfall along the west coast of Scotland. Slow changes of climate may cause a change of storm paths and a redistribution of rainfall. These evidences of climatic change must be associated in some way, which is not yet understood, with the energy reaching the earth from the sun.

Because of the many relationships among various terrestrial phenomena and their general association with solar phenomena, and because various new

methods of investigation have been developed since the second Polar Year, the suggestion was made some 4 years ago that a third Polar Year should be organized for a concerted attack on the many problems that need to be solved. The proposal was endorsed by the three international scientific unions primarily concerned—Astronomy, Scientific Radio, and Geodesy and Geophysics. The recommendations of these unions were approved by their parent body, the International Council of Scientific Unions, which widened the scope of the scheme to cover the whole globe instead of being confined to the polar regions and gave it the title "International Geophysical Year." An international committee was appointed to develop the plans for the enterprise, and it has decided that the International Geophysical Year will extend from July 1957 to December 1958; therefore, the "year" will have 18 months. It will follow the second Polar Year by 25 years. That this great international scientific enterprise should be needed so soon after the second Polar Year is an indication of the pace at which science is advancing.

A vast scheme. The planning for such a vast scheme must necessarily start some years ahead. The proposals for setting up temporary observing stations, many of which will be in regions of the earth that are remote, inhospitable, and difficult of access, will have to be considered by the nations concerned. Many special instruments will have to be made, and scientists will have to be selected and trained to man the stations and to make the observations. So 1957-58 is about the earliest for which the scheme could be organized. This epoch has one great advantage: in 1954 the sun passed through a minimum of activity and by 1958 its activity should be at or near a maximum. Large spots, as well as bright eruptions, are likely to occur frequently, thus permitting the terrestrial effects associated with these phenomena to be studied. The second Polar Year, on the other hand, came at a time of minimum activity.

For the investigation of the relationships between solar and terrestrial phenomena, the sun will be kept under observation by all the observatories and institutions engaged in solar investigation. For some years a cooperative scheme has been in existence whereby each observatory undertakes to observe the sun for a certain period of the day, weather permitting, so that a fairly continuous watch is kept on the sun. These normal hours will be extended to insure that, insofar as possible, the sun is under observation throughout the whole 24 hours of each day. The sun will be observed visually, by photography, and by radio. At some observatories photographs will be made automatically on cinema

film at short intervals throughout the day. The general magnetic field of the sun and the large localized fields associated with sunspots and other disturbed areas will be measured regularly. The sun's corona will be kept under observation at high-altitude observatories. It is of great importance that the various geophysical observations be made at times when a bright eruption or other major disturbance occurs on the sun. But they cannot be predicted in advance, although it is possible to state a few days ahead that a disturbance is likely to develop. Arrangements are therefore being made to issue a warning, or alert, to observers through communication networks, so that they will be in readiness.

Special methods of observation will be used to supplement observations from the ground. Balloons, which will ascend to heights up to about 20 miles, will be widely used and will carry either recording equipment or equipment that will telemeter information back to the ground. They will provide information on the density, pressure, and temperature of the atmosphere and on the velocities of the wind at different heights. They will also be used to provide information about the flux of cosmic rays at these heights.

Use of rockets. Important additional data will be obtained by the use of rockets, which can carry 150 pounds of equipment to heights of about 125 miles, and "rockoons" (the name given to the smaller rockets launched from aircraft or from balloons), which carry 50 pounds of equipment to heights of about 50 miles. The rockets can be used to find out about the electric currents high up in the atmosphere that are the cause of some of the observed variations in the earth's magnetic field. They will pass through the ozone layer which, by absorbing the far, ultraviolet radiation from the sun, protects the earth from its damaging effects. The height and extent of this layer will be measured. On passing through it the spectrum of the sun in the far, ultraviolet region will be photographed. Information will be obtained on the various ionized layers in the ionosphere. The temperature, density, pressure, and composition of the atmosphere and the wind velocities at great heights will be measured. The rocket observations will also contribute information on cosmic rays. Photographs of the earth's surface from balloons, rockoons, and rockets will give information on the distribution of clouds, snow, and ice over large areas of the globe. Since the incoming solar radiation is strongly reflected by clouds, snow, and ice, their amount and distribution may be associated with large-scale variations in our weather.

In order to gather as much useful data as pos-

sible, all observatories and institutions that regularly make geophysical observations will observe more intensively throughout the geophysical year, in accordance with the recommendations of the International Committee. But there are considerable gaps between these permanent stations; therefore, plans for temporary stations to fill such gaps have been drawn up with a view to the special programs of observation planned for the geophysical year.

Three regions of the globe are of special importance in many geophysical investigations: the arctic, the antarctic, and the equatorial belt. The antarctic is a large continent that lies almost entirely within the Antarctic Circle and is covered with a huge mass of ice. It is the coldest and windiest region of the globe. I have already referred to its importance for world weather; its influence on the circulation of the atmosphere and on the water in the oceans must be great. The aurora australis has hardly been studied at all and the southern zone of maximum auroral frequency has not been properly mapped. It is important to find whether the aurora australis differs in its characteristics from those of the aurora borealis. The long winter of the antarctic continent, with a prolonged absence of sunlight, will enable the physical characteristics of the ionosphere to be studied. I have already mentioned the importance of the polar regions for geomagnetic observations.

In the antarctic region, 11 stations on the continent or below the Antarctic Circle and 10 on the surrounding islands have been planned or are already in operation; one of these stations will be at or near the South Pole. It is hoped that arrangements can be made to establish eight additional stations to fill the more important gaps. Never before will the antarctic have been so well populated.

The arctic region is favorably situated for observing the auroral zone. Much of it lies in or is adjacent to Soviet territory, and it is gratifying that the Soviet Union has agreed to cooperate fully in the observations to be made during the Geophysical Year. Greenland is a region of special interest, since it lies within the auroral belt and extends from near the north magnetic pole almost to that belt. It is hoped that several stations will be established in Greenland for the Geophysical Year.

Airglow in equatorial regions. The equatorial region is an important one for investigating the earth's magnetism, the ionosphere, the airglow, and cosmic rays. We have recently come to believe that high up in the atmosphere electric currents circulate around the magnetic equator and that they cause the changes in the magnetic field that are greatest at places on or near the magnetic equator. Several temporary stations in this region are

planned for investigating how the magnitude of these changes depends on the latitude north or south of the magnetic equator. Observations of the so-called airglow in equatorial regions are much needed. This airglow is the faint intrinsic light of the night sky, whose brightness depends on the latitude and on the sunspot cycle; it also varies through the night and through the year. Its relationship to the aurora, if there is any, should be investigated.

In meteorology the principle subject to be investigated is the circulation of the atmosphere and its transport of angular momentum and energy. With the alternation of summer and winter there is a transfer of air backward and forward between the two hemispheres; when it is summer in either hemisphere the air becomes heated and expands into the other hemisphere. The movements of these air masses are influenced by the rotation of the earth; this makes the problem of the circulation of the atmosphere at different heights very complicated. During the Geophysical Year, chains of stations will be established along the three meridians of 80° W, 10° E, and 140° E that have been selected because they pass through or near major land masses. The observations at these stations will be combined with data from balloons and rockets to provide information for the study of the circulation of the atmosphere.

Plans for the Geophysical Year also include a world-wide program of determinations of longitude and latitude. The seasonal displacements of large air masses tilt the earth's axis slightly, causing an annual variation in observed latitudes; the seasonal changes in the angular momentum transported by the winds are compensated by corresponding changes in the angular momentum of the earth itself; this results in a seasonal variation in the rate of rotation of the earth and, hence, of measured longitudes. These effects will be investigated in conjunction with the meteorologic data. The observed times of reception of time signals will provide important information to the radio physicist about the velocities of long and short radio waves and their dependence on conditions in the ionosphere.

Regular World Days. For some purposes it is desirable to have simultaneous observations of all the interrelated phenomena; therefore, 2 days in each month, to be known as "Regular World Days," have been selected for concentrated observations at all stations. One of these days will be at new moon, and the other will be at or near quarter-moon. Some additional World Days have been added because of an eclipse of the sun or of expected meteoric activity. For the investigation of

atmospheric movement, some periods longer than a day are necessary; therefore, during each quarter an interval of 10 consecutive days, to be known as a "World Meteorological Interval," has been selected for intensive meteorologic observation.

The alert, when unusual solar activity appears probable, will be a warning to observers that a period of special concentrated observation is likely to be declared within 4 to 6 days. At least 12 hours' notice will be given if observations are to be started, in what is termed a "Special World Interval," and they will then be continued until ended by an all-clear notification.

The International Geophysical Year will be the largest scheme for international cooperation in science that has ever been planned. Its success is assured, for the cooperation of 36 countries, including the Soviet Union, has already been promised. It will undoubtedly add greatly to knowledge and cannot but help materially in the solution of many problems in geophysics.

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Young Men in the Sciences

"When were you at your mental prime?" It is the rare man indeed who will not answer: "I'm at my prime right now."

Hence, when recognition finally comes to the successful physicist, and a biographer requests a picture, he invariably receives one of recent date. Of course, before the popularity of photography, it was only a recognized success who was in possession of a likeness of himself. But even today, the pictures that adorn our textbooks and propose to inspire our students are too often those of dignified elderly gentlemen.

The writer holds no prejudice against dignified elderly gentlemen; indeed, it is his ambition some day to become one. However, this custom of illustrating textbooks and biographies with likenesses taken in age has created a misconception in the minds of students. The picture of a mature, bearded Galileo dropping objects from the Tower of Pisa belies the fact that his investigations on freely falling bodies were performed at the age of 27.

The effect of this false conception upon the attitude of the young student is very real. An age barrier is placed between him and the men whose work he studies. This barrier makes the material he reads less real to him. He finds little in common between his normal self and one whom he considers an aged man of abnormal mentality—a man who probably spent all his life in academic pursuits with no semblance of a normal existence.

The knowledge that so many important discoveries in physics have been made by young men comes as a surprise to most students—and a pleasant surprise. Students never fail to look with new interest upon work done by a man at very nearly their own age. Physics is revitalized in the minds of the students by the knowledge that it is a field for *young men*—men like themselves.—K. L. YUDOWITCH. [Reprinted from *American Journal of Physics*, 15, 191 (1947)].

BOOK REVIEWS

Exploring Mars. Robert S. Richardson. McGraw-Hill, New York-London, 1954. 261 pp. Illus. + plates. \$4.

The author is an astronomer at Mount Wilson and Palomar observatories in California. He has been interested in Mars from boyhood, and this book is a definitive development of his interest in a scientific analysis of conditions on that planet. Conditions on Mars include very low, if any, oxygen in the atmosphere, low water-vapor content, arid deserts, low atmospheric pressure, probably water in the form of ice, and probably low forms of plant life. An uninspiring picture but not beyond engineering ability to establish colonies—once we get there!

This book also describes elementary rockets and the astragulation theory. A brief description of the other planets and of their planetary conditions is given. It is very well written, and the speculative material is carefully differentiated from the conditions that have been observed on the planets. In some respects the book reminds one that it might be a preview of a textbook of tomorrow.

The format of this book is very good, and the illustrations and diagrams are well selected. *Exploring Mars* is a pleasure to read, and it contains an amazing amount of information. Richardson is to be congratulated on helping to develop a modern understanding of the planetary bodies that may offset some of the current fictional ideas.

THOMAS S. GARDNER

Hoffmann-La Roche, Inc.

Soil. G. V. Jacks. Philosophical Library, New York, 1954. ix + 221 pp. Illus. + plates. \$5.

The book makes interesting and instructive reading for anyone concerned with soils and their utilization and preservation. The relationship between soil characteristics and living things, including plants, animals, microorganisms, and especially man, is emphasized. The idea presented is that different types of plants induce the development of a soil especially adapted to their needs or one in which they can resist the intrusion of other plants.

Much emphasis is placed on soil structure and on the ability of grass to develop a stable crumb structure. The role of grass in the maintenance of productivity is referred to frequently. Contrasts among soils growing conifers, hardwoods, grass, and farm crops are drawn. The possibility of increasing productivity by making use of our knowledge of soil science is pointed out.

An unusual amount of space—two chapters—is devoted to the activities of soil flora and fauna. Nevertheless, the chemistry of the soil is not neglected and ample space is given to soil moisture considerations. The problem of erosion is discussed, and the place of

a high state of productivity in the control of erosion and the reforestation of rough land are emphasized. One chapter is devoted to soil classification, and the one dealing with the history of British soils is enlightening.

The author shows originality in thought and unusual clearness of expression. Although one gathers that the volume was prepared primarily for those with little scientific training, the author's fund of scientific knowledge occasionally leads him to forget the limitations of his chosen audience. The book is worthy of a careful reading, but it is not designed as a textbook.

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The Origins of Psychoanalysis. Letters to Wilhelm Fliess, drafts and notes: 1887-1902, by Sigmund Freud. Marie Bonaparte, Anna Freud, and Ernst Kris, Eds. Trans. by Eric Mosbacher and James Strachey. Basic Books, New York, 1954. xi + 486 pp. Illus. \$6.75.

The publication of this series of letters and working papers, acceptably translated into English, opens to a wide audience the possibility of listening to an authentic scientific genius in the throes of discovery and creation as he revealed himself to an intimate intellectual friend. In the words of the editors,

They amplify the prehistory and early history of psychoanalysis in a way that no other available material does, provide insight into certain phases of Freud's intellectual processes from his first clinical impressions until the formulation of his theory, throw light on the blind alleys and wrong roads into which he was diverted in the process of hypothesis-building, and furnish a vivid picture of him during the difficult years during which his interest shifted from physiology and neurology to psychology and psychopathology (p. x).

The reader should be warned, however, that approximately one-half of the book—the drafts and particularly the long "Project for a scientific psychology"—will be difficult for anyone who is not acquainted with the technicalities of psychoanalysis. Kris has furnished an excellent interpretive introduction that gives the general background of the correspondence and numerous footnotes, mostly pointing out links to Freud's later, published work. Nevertheless, the reader's task could have been made easier by more interpolated materials relating the letters to events in the lives of Freud and Fliess.

Much fascinating detail about Freud's life and personality abounds in the letters, and they are an invaluable source for the student of psychoanalytic theory, illuminating in countless ways its origins and develop-

ment. Of more general scientific interest, however, may be the glimpses they afford into Freud's scientific workshop.

Better than in any of his published writings, we can see here the way his clinical and theoretical thinking proceeded and developed as he forged a new tool of scientific inquiry, with its own special strengths and weaknesses. Finally, Freud gives in several places a number of revealing introspections to add to our all-too-meager knowledge of the subjective experience of scientific creation and discovery in men of genius.

ROBERT R. HOLT

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Suicide and Homicide. Some economic, sociological and psychological aspects of aggression. Andrew F. Henry and James F. Short, Jr. Free Press, Glencoe, Ill., 1954. 214 pp. Illus. \$4.

The authors of this book raise a number of interesting questions and give an impressive array of computations and speculations to provide answers to these questions. They attempt to go beyond the obvious interpretations of correlations of social phenomena and business cycles in terms of the impact of variations in well-being or economic opportunities and to assess their findings in relation to sociopsychological concepts. Starting with three assumptions—"(1) aggression is often a consequence of frustration; (2) business cycles produce variation in the hierarchical ranking of persons and groups; (3) frustrations are generated by interference with the 'goal response' of maintaining a constant or rising position in a status hierarchy relative to the status position of others in the same status reference system"—they proceed to an empirical analysis of "the relation of suicide and homicide to the business cycle in the United States in the search for a theoretical connection between the economic correlates of suicide and homicide and their social and psychological aspects" (p. 14). The statistical presentation is, however, so confusing that it is impossible to form any judgement of the applicability of hypotheses to findings.

Arrays of correlation coefficients computed between deviations from trends fitted to an index of business cycles and to annual "series" of homicides and suicides for varying periods from 1900 to 1947 are presented. The series are not defined precisely; the sources are not made explicit; and the basic data are not shown. With regard to definitions, "suicide and homicide are treated throughout as our main dependent variables and are defined operationally in terms of the definitions governing official compilations of suicide and crime statistics" (p. 13). Correspondingly, the independent variable is defined operationally as "the Cleveland Trust Company's index of 'American Business Activity since 1790,' commonly referred to as 'Ayres' Index' because Leonard P. Ayres developed the index" (p. 142). Its components are neither described nor evaluated.

In Table 1 correlations of "suicide categories" are

presented for the United States Death Registration area, defined only as including "those states for which data on suicide are collected by the United States Bureau of Vital Statistics." There is no indication of the extent or possible effects of the changing coverage of the death registration area. There is no indication of whether "rates" or "numbers" are used in the suicide series, although the text suggests that the two may have been used interchangeably. We learn belatedly that, contrary to the implications of the quotation from page 13, some homicide series are derived from vital statistics rather than from crime reports but we are not informed that homicides based on cause of death data include justifiable and excusable homicides; and that police reports, upon which the authors also drew, may or may not include negligent manslaughter and may thus be differentially influenced by deaths from automobile accidents, which must have a tenuous connection with the frustration-aggression hypothesis.

The book abounds with improper table headings, for example, homicides are apparently called "murders," and vice versa (pp. 83, 88); and columns headed "per cent" refer, in fact, to proportions (pp. 30, 31). There are almost eight pages of "equations of trend lines," computed "by the least squares method." The formulas are expressed indiscriminately as $X_1 = a + bY$ (p. 145), $Y_1 = a + bY$ (p. 146), and $X_1 = a + bx$ (p. 149), with no explanation of the difference in meaning between capital and lower-case x 's and y 's, or why the x formulas contain no y 's, and vice versa. There is no indication of whether or not the origin is at the initial or middle observation, and the equations are not, therefore, readily manipulable by other investigators, even assuming, in the absence of any specific references to sources, that these investigators could find the series of data on which the trends are computed. Again, I could find no indication of whether deviations from trends were measured in terms of absolute or percentage deviations, but inasmuch as the methods are said to be "those employed by Ogburn and Thomas" (p. 141), I infer that they are percentages.

I share the writers' implicit skepticism about the use of standard errors of correlation coefficients, but when they say that "throughout the correlational analysis, the test of replication is applied rather than the test of the standard error of individual time series correlation coefficients" (p. 29), I find their concept of "replication" confusing. What they mean, apparently, is consistency in correlations when data are analyzed separately for whites and nonwhites, for different age groups, for the two sexes, and so on. But, on the basis of "theory," they have "predicted" differential sensitivity to the business cycle of different "status groups," among which are "high-status" males versus "low-status" females. The test of consistency is, therefore, difficult to interpret, as is seen in the following quotation: "The correlation between homicide of *males* admitted to state and federal prisons and reformatories and the business cycle is 0.01, as compared to a coefficient of correlation of 0.15 for the series of females. These correlations, and their differences, are small. The differences are in the direction predicted by our hypo-

thesis, however. Homicide of lower status females may have a stronger positive correlation with the business cycle than homicide of males who hold a relatively higher position in the status hierarchy" (p. 52). Inasmuch as these time series covered the period 1926-41 and $n=16$, computation of the standard errors might have provided a useful safeguard against attributing any significance whatsoever to these correlation coefficients.

Many of the errors, of which the foregoing represent a partial list, might have been condoned had the authors presented their data so that "replication" in the sense of "repeating" and thus checking their calculations could be accomplished. Without the possibility of such checking, we are left with a set of very interesting hypotheses that are certainly worthy of further exploration.

DOROTHY S. THOMAS

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Cryptogamic Botany. Gilbert M. Smith. vol. 1, *Algae and Fungi*. ix + 546 pp. Illus. \$8.50. vol. II, *Bryophytes and Pteridophytes*. vii + 399 pp. Illus. \$8.00. McGraw-Hill, New York-London, ed. 2, 1955.

The first edition of these companion textbooks was published in 1938. This undertaking by one author of presenting the principal facts regarding the structure, life-histories, and classification of such a diversity of plant groups required not only depth and breadth of knowledge but courage, energy, and industry as well. That Gilbert Smith was successful, however, is attested by the fact that the preparation of a second edition has become desirable. Those who have used the first edition will certainly welcome the second.

As the author says, "The general plan of the first edition has been followed in this revised edition." But much of the text has been rewritten, and many changes have been made to correct errors and to make certain treatments more adequate. Furthermore, several new forms, as well as facts, have been added, especially in the lower cryptograms and the bryophytes; and certain "types," which have a wider geographic distribution and are, therefore, better known and more generally available, have been substituted for some of those used in the first edition. To the bibliographies have also been added many important contributions, which were either overlooked in the preparation of the first edition or have appeared since the time of its publication. All these changes, together with several new illustrations scattered throughout, give the two volumes a fresh look. But despite these changes and additions, the author has succeeded in keeping the size essentially the same.

In the preparation of the new edition, the author has no doubt profited by many criticisms of the first. But to accept all criticisms, especially from specialists in the various groups, as applied to general textbooks of this level, can hardly be expected. The mycologist will no doubt be dissatisfied with the much smaller proportion (nearly one-half) of pages devoted to fungi than to algae, and the lichenologist will deplore the fact that

only 10 pages are devoted to his specialty. Even the phycologist, who is given the largest share of the lower cryptogams, may complain that *Sargassum*, which is probably the most highly evolved of the Phaeophyta, if not of all algae, has barely been mentioned.

In general, this revised edition is markedly superior to the first and should, therefore, fulfill more adequately the purposes for which these textbooks have been prepared and published.

H. L. BLOMQUIST

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Forest Entomology in Hawaii. Special Publ. 44. Otto H. Swezey. R. H. Van Zwaluwenburg, Ed. Bernice P. Bishop Museum, Honolulu, 1954. 266 pp.

This volume, which contains the results of 50 years of patient, careful observation by an excellent field naturalist, is of much more general interest and importance than its title might suggest. It is a record of the relationships—primary and secondary, obligate, facultative, and casual—between insects and native Hawaiian plants, not at all restricted to forest trees. This information is arranged by the plant groups concerned, and under the plant groups, by the insects, with the primary relationships arranged systematically and secondary or parasitic relationships arranged under the insects noted in the primary relationship. The type of primary relationships most commonly observed are direct food relationships with both living and dead plants, parasitism, and the use of the plant as hunting ground and shelter. Surprisingly lacking is any mention whatever of pollination of plants by insects, although some of the flower feeding must probably result in pollination.

The information presented in this book should be of substantial interest to those concerned with plant and animal geography, ecology, evolution, phytopathology, and parasitism, as well as to general and economic entomologists. When any general ecological works are written on Hawaiian forests or other vegetation types, the information in this book will be basic.

F. R. FOSBERG

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Poliomyelitis. World Health Organization, Monogr. Ser. No. 26. WHO, Geneva, 1955. 408 pp. Illus. Cloth, \$8.

Poliomyelitis and problems of the Salk vaccine are being drummed constantly by our radio, television, and newspapers as this review is written. It is a tossup as to who is more confused—laymen or doctors. For those responsible for this circus the answers are sometimes *Yes*, sometimes *No*, but they are never in doubt. For those who do not know all the answers and who would like accurate, up-to-date information on this modern pestilence, the monograph *Poliomyelitis* is an excellent help. All the aspects of the subject have been treated by experts from both sides of the Atlantic.

There are four chapters dealing with epidemiology

and control by Paul, Gear, Freyche and Nielsen, and Payne, respectively. The section by Sabin on immunity, with special reference to vaccination, is excellent, as are the companion chapters on live virus vaccine by Koprowski and on passive immunization by Hammon. Gard discusses the physical and chemical aspects of poliovirus. Enders contributes a valuable chapter on the present status of tissue culture techniques. A detailed section on laboratory tests in diagnosis is written by Rhodes, Wood, and Duncan. Fully one-quarter of the book is devoted to clinical aspects—for example, symptomatology and diagnosis by Debré and Thieffry, management of the acute stage by Russell, and respiratory and bulbar paralysis by Lassen. This last chapter is very complete and full of wisdom, and it has excellent photographs.

One of the most interesting topics, namely, the "sanitation" theory to explain epidemics, is discussed or mentioned in four different places. Although this might seem repetitious and unnecessary, actually it is not so, perhaps because of the different approaches used. Briefly, the "sanitation" theory offers a plausible reason for the fact that epidemics mainly strike Scandinavia, North America, Australia, and New Zealand. Modern sanitation and hygiene are relatively well advanced in these countries. In many other parts of the world, where poliomyelitis is known to occur in *endemic* form, more primitive sanitary conditions occur, and fecal virus has more chance of dissemination. Babies are immunized early by these natural means, and the population is thereby solidly protected against epidemics. In the afore-mentioned "cleaner" areas, there is less opportunity for such natural exposure. Consequently, the population is susceptible to periodic epidemics in which progressively older age groups are involved.

This is a complete book on poliomyelitis—the best available in a long time.

ROBERT WARD

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The Nihilism of John Dewey. Paul K. Crosser. Philosophical Library, New York, 1955. xi + 238 pp. \$3.75.

Having known John Dewey some 40 years, as a visitor in my home, and in many conversations, and having read sparingly of his writings, I find myself with a well-defined prejudice that militates against an impartial review of this book. Paul Crosser, the author, is also deeply prejudiced, a fact that guarantees an equal partiality. He sets out to prove Dewey's nihilism and contradictions. All this would seem unnecessary, because Dewey proves it himself.

The book is rich in examples of negativism and inconsistency quoted from Dewey. The author's animus is exhibited in the titles of the three sections of the book: "In place of science," "In lieu of art," and "Instead of education." It is not so much the nihilism and contradictions that are shown, as it is Dewey's obfuscation of the subjects. Dewey, not a biologist, writes about life, a congeries of biological phenomena, and exhibits

philosophy mixed with misconceptions of biology. It is not a pretty picture. Crosser goes after Dewey mercilessly and calls Dewey's thesis "the degradation of knowledge."

It is shown that Dewey is guilty of "dissipation of the sense of beauty"; and, under education, that Dewey has promoted "the suspension of learning and teaching." Crosser says, "Dewey has made America lose its perspective and has thus greatly weakened the intellectual potential of American leadership at home and abroad." This is the exaggerated notion of one philosopher's idea of the potentiality of another. Dewey has done no such harm to his country. Crosser writes here in plain English; but both these authors, Dewey and Crosser, generally avoid seeming obvious or too rational. This, however, has been the practice of philosophers since Socrates.

John Dewey was not a great philosopher. He lacked cogency and clarity and was without a sense of humor-capacity to see and enjoy his own deficiencies. But he was something more. He was a humanist, and in his humanism he exhibited neither negativism nor inconsistency. He was a splendid human being.

Scanning this book has brought to memory an occasion when I was walking across the campus of an American college with its president. I asked, "How do you get along with your department of philosophy?" He replied, "Fine; I haven't the faintest idea what they are driving at, and I don't think they have either."

JAMES PETER WARBASE

Woods Hole, Massachusetts

50 Jahre Arzneimittel Forschung. C. L. Lautenschläger.

Thieme, Stuttgart, 1955 (order from Intercontinental Medical Book Corp., New York 16). 486 pp. \$8.60.

The title of this book is derived from Lautenschläger's 50 years of study and research in the field of pharmaceutical chemistry. The volume logically divides and classifies the wide range of medicinal products into three sections. Part I takes up the agents used for the prophylaxis and therapy of infectious diseases. Prophylactic measures, including hygienic procedures, chemical methods of sterilization, and physical methods, are surveyed. Therapy with specific agents, for example, antigens, vaccines, and serums, is included. The consideration of chemotherapeutic agents covers approximately 100 pages. Part II devotes about 160 pages to the biological catalysts—the hormones, enzymes, and vitamins—under 32 headings. Part III treats the pharmacotherapeutic agents used against the symptoms of disease under 18 headings, for example, anesthetics, analgesics, and antihistamines.

Several characteristics of the book deserve special mention. For many substances, the chronology of discovery is set forth in excellent detail. The structure of most compounds is shown by formulas, and some methods of preparation and synthesis are indicated in considerable detail. Some specific literature citations are given, and the general literature, with emphasis on German publications and without specific citation, fol-

lows various groups of products. Although there is an adequate table of contents, the usefulness of the book is limited by the absence of an index.

The author has succeeded in depicting the developments in pharmaceutical chemistry during the past 50 years in an interesting and well-organized manner. Scientific and professional workers in drug research should find this book of value for reference purposes.

GLENN L. JENKINS

School of Pharmacy, Purdue University

A Field Guide to Animal Tracks. Olaus J. Murie. Peterson Field Guide Series, No. 9. Roger Tory Peterson, Ed. Houghton Mifflin, Boston, 1954. xxii + 374 pp. Illus. \$3.75.

This book fills a real need. The bulk of it deals with tracks and other signs of mammals; the last chapters briefly describe tracks and signs of birds, reptiles, amphibians, insects, and other invertebrates; feeding signs on twigs and limbs; and chewing of bone and horn. There is an eight-page bibliography and index.

The mammals are taken up family by family, with the text presenting a highly readable discussion of tracks and relevant natural history to supplement the drawings, which are well organized and effective. There is frequent, pleasant, and easy recalling of the author's experiences in the field, but one soon realizes that a great deal of information has been compressed into the book. It is surprising to find that the snowy owl and jaegers are not considered among the birds that produce pellets. Also, the drawings of scats sometimes suggest diagnostic characters merely because, for practical reasons, the material originally available or the space available for drawing did not allow the author to deal with variation. But it is up to the field-worker to take the cues provided by this book and to work with variation himself.

The author is well known as a mammalogist, naturalist, and conservationist, and his book represents a summation of more than three decades of study and experience. As Roger Tory Peterson points out in his prefatory editor's note, this is a book that will be used widely both by amateur naturalists and by professional wildlife technicians and biologists.

FRANK A. PITELKA

*Museum of Vertebrate Zoology,
University of California, Berkeley*

How to Know the Minerals and Rocks. Richard M. Pearl. McGraw-Hill, New York-London, 1955. 192 pp. Illus. + plates. \$3.50.

This practical field guide to some 125 minerals, rocks, gems, ores, and meteorites is written for the beginner and amateur collector. As an aid to recognition, a drawing that shows typical characteristics is given of each mineral and rock specimen. In addition, 46 attractive, colored illustrations of minerals are reproduced by courtesy of Ward's Natural Science Establishment.

The seven keys to recognizing minerals are luster,

hardness, color, streak, cleavage, fracture, and specific gravity; this follows a procedure used successfully in mineralogy for many years.

The four keys to recognizing rocks are stated in order to "... make it easy to identify the chief types by a simple but systematic procedure." The rock keys are texture and structure, color, acid test, and mineral content. But the keys given for some rocks, such as shale, schist, and slate, belonging to different fundamental classes are almost the same, and the discussion lacks sufficient diagnostic points to attain exactness in nomenclature. Plagioclase is omitted as an essential mineral of basalts, although the author lists the classical occurrences of basalts at the Giant's Causeway of Ireland, the Hawaiian Islands, the Columbia River region, and the Deccan Peninsula of India. The allotment of a single page to each mineral or rock offers the advantage of a uniform treatment, but prevents the adjustment of informative material on the basis of importance and difficulties of classification.

The author is at his best in his discussion of the enthusiastic reception of mineral collecting and of the astounding growth of mineral and gem clubs and federations throughout the United States. It is to this group of hobbyists that he directs his suggestions on mineral collecting, arranging, mounting, polishing, labeling, and displaying minerals and rock specimens.

VICTOR T. ALLEN

*Department of Geology, Institute of Technology,
Saint Louis University*

A Guide to the Planets. Patrick Moore. Norton, New York, 1954. 254 pp. Illus. + plates. \$4.95.

"We must revise our ideas about the planets. Far from being remote inaccessible worlds, they have become possible colonies." This quotation from Patrick Moore's book suggests why he calls it a guide. It is a companion piece to his *A Guide to the Moon* in which, in the course of providing the future moon traveler with data concerning the "things to see," he provides us also with an authentic treatment of that satellite. The new volume is not quite as pleasing, although it also is authoritative and smoothly written.

There should be no objection to Moore's comments on the space travel of the future, or to the admittedly speculative treatment of the future colonization of Mars. And, if the author had not been so positive about the future of the sun's radiation, it would have been rather difficult to find items to criticize seriously in his *A Guide to the Planets*. But here are two statements that he may regret after the astrophysicists have gone deeper into the energy problems of stars: "As the Sun ages, it is growing steadily hotter. There can be no doubt about this; in the far future, thousands of millions of years ahead yet, the oceans will boil . . ." (For the past half-billion years and more there has been no "steadily hotter" evidence.) "In the remote past, the Sun was responsible for the creation of the Earth; in the end, it will inevitably destroy its own child." The word *inevitably* is regrettable, and even *possibly* would be a

big extrapolation from the evidence and sound theories of the present time.

This volume, however, like its companion piece on the Moon, is hard to put down. The planets are surveyed one by one in separate chapters; and additional chapters on the mechanism of the solar system, the possibility of planets beyond Pluto, the Martian base (for space ships), and life on the planets enliven the story.

The fantasy on the travels to Mars is more than first-rate science fiction. It carries with it some practical suggestions and thoughtful observations, for example: "It is improbable that the Martian expedition will start from the surface of the Earth. It may leave from the Moon, but more probably from an artificial satellite circling the Earth. . . . Needless to say, we are looking centuries ahead. The first Martian expedition may be on its way by the year 2100; the Base may have been established by 2150; by 2200, much of the planet may have been explored, and reconnaissance parties sent out to Venus."

The volume concludes with some useful appendixes on work for the amateur, astronomical societies, and planetary literature. The author reminds us that there are about 100,000 amateur astronomers in the United States and more than 100 cities have their astronomical societies, federated under the name of the Astronomical League, an organization that has grown remarkably since I was its first president about 10 years ago. A great many competent amateurs now busy themselves with the stars, but this volume by Patrick Moore should awaken both amateur and professional interest in the Sun's family of planets.

HARLOW SHAPLEY

Harvard College Observatory

Aspects of Deep Sea Biology. N. B. Marshall. Illustrated by Olga Marshall. Philosophical Library, New York, 1954. 380 pp. Illus. + plates. \$10.

Of the total space on earth in which organisms may live, the greatest, by more than 200 times, is that provided by the deep waters of the ocean. Yet we have barely begun to learn about this environment, its characteristics, and its inhabitants. Adequate measuring of currents and temperatures and sampling of its water are difficult problems that many oceanographers are still attempting to solve, although biological sampling is still more unsatisfactory. Nevertheless, our knowledge is steadily growing, and this book is the first general inventory since the chapters in Murray and Hjort's *Depths of the Ocean*, which is now more than 40 years old.

In giving his book the title, *Aspects of Deep Sea Biology*, the author makes it plain that it is not to be considered comprehensive in every sense of the word, but that it is concerned principally with those subjects in which he is most interested. He is fully aware of the preliminary status of most of our knowledge, especially in the later chapters, but more emphasis should have been placed in the earlier chapters on the deficiencies of sampling techniques. For example, in dis-

cussing the vertical distribution of organisms postulated by students of the Dana collections, it is not clearly pointed out that most of these conclusions were based on the use of open nets that fish while descending and ascending. There also seems to be too much taken for granted in the discussion of plants in deep water, a matter that many marine botanists consider questionable. When the author turns to topics within his own field of research—the scattering layer and the biology of deep sea fishes—his treatment is more satisfactory in both detail and critical discussion, and more material has been assembled here on these subjects than in any other book in English. As a whole, biologists will find this book a valuable introduction to the literature, and the general reader will find it a mine of curious and interesting information. The illustrations are for the most part well done and attractive, except for the lack of scales on the maps.

Although this book is available in England for 35s. (\$4.90), the American publishers have doubled the price. This is apparently on the theory that any book with color plates should be expensive, for it is hard to believe that the costs of importing are so great that they justify this almost prohibitive increase.

JOEL W. HEDGPETH

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Public Education under Criticism. C. Winfield Scott and Clyde M. Hill, Eds. Prentice-Hall, New York, 1954. xiv + 414 pp. \$6.35.

This book is a comprehensive, serviceable anthology of more than 100 recent articles dealing with criticism of our public schools. A very careful procedure for selection was used, and certainly the most representative articles are to be found in the anthology. Selections are included from such well-known personalities as Bernard Iddings Bell, James B. Conant, Harry Emerson Fosdick, Herold C. Hunt, Robert M. Hutchins, Roy E. Larsen, Agnes E. Meyer, and Dorothy Thompson. The articles selected have been published in many of the best-known and most popular journals.

The organization of the book is very helpful. Those interested in reviewing recent criticism of the schools can read sections of special interest to them or they can read the entire anthology. The selections representing both sides of the controversy, are grouped under the headings: "General and philosophical criticisms," "Progressive education," "The fundamentals," "Religion," "The social studies," "Teacher education and teachers," and "General defenses." Also included are many of the best evaluations of critics and of the criticisms. Another section contains articles that have been written to advise those responsible for public education on how to handle criticisms. In the introduction and in the concluding statements, the authors indicate the methods that they have used and also suggest generalizations for constructive action.

Scott and Hill, professors of education in the Graduate School, Yale University, are well able to make a

scholarly selection among the published criticisms and to give critical analyses of them. This book can be recommended to all thoughtful people and, particularly, to scientists who are interested in becoming better informed about the various issues related to public education. As an indication of the interest of the public in criticism of our schools, the authors point out that *Education Index* included only three such articles in 1942, the year in which the heading "Public schools—criticism" was first used, and included 49 such articles in 1952. It is to be expected that the Great Debate will continue for some time and it is to be hoped that readers of *The Scientific Monthly* can add substantially to the constructive criticism. This book provides background for those who wish to record their opinions on this fundamental issue.

JOHN R. MAYOR

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The Micmac Indians of Eastern Canada. Wilson D. Wallis and Ruth Sawtell Wallis. Univ. of Minnesota Press, Minneapolis, 1955. xv + 515 pp. Illus. \$7.50.

In 1911 and 1912, at the suggestion of Frank Speck, Wilson D. Wallis, then a young man, visited the Micmac Indians of the Maritime Provinces in order to make ethnographic studies.

He found the Indians to be reluctant and uncooperative informants on matters relating to their native customs. From the women he was able to learn virtually nothing. In one respect, however, he was very successful. Some of the old men who were famous story tellers could not resist the urge to indulge in their specialty. In the large body of folk tales and myths thus secured is embedded a wealth of ethnological detail.

In 1950 and 1953, Wallis, in company with his wife, Ruth Wallis, revisited the tribe. This time the ethnologists found the Micmacs friendly and willing to talk freely. However, during the intervening years, the native culture had broken down badly and much of the memory of it had been lost.

With a documentary history extending back more than four centuries and with personal field trips spanning a 40-year period, there was a fine opportunity to present a picture of cultural change over a long period, especially since the greatest change took place during the last half-century.

The rich material in the *Jesuit Relations* between 1606 and 1739 afforded the authors a clear picture of aboriginal life among the Micmac. During the period between this and the first visits of Wilson Wallis, there are enough descriptions to fill the gap in a satisfactory manner.

The book is arranged in two parts. The first, entitled "Tribal life" (300 pp.), is a monograph containing about all that can be gleaned in general ethnology, such as social and political organization, material culture, supernatural beliefs, and general tribal activities. The second section (about 200 pp.) is entitled "Folktales

and traditions," and contains 144 stories collected on the 1911 and 1912 field trips. Each section has its own bibliography, and there are three appendices of zoological, botanical, and anatomical terms in the Micmac language.

This is an important book by a well-known anthropologist on an important tribe, and it will probably remain the definitive work on the Micmac since it is unlikely that much new information will be gathered by future investigators.

MATTHEW W. STIRLING

*Bureau of American Ethnology,
Smithsonian Institution*

Laboratory Instrumentation in Psychology. William W. Grings. National Press, Palo Alto, Calif., 1954. vi + 282 pp. Illus. \$4.75.

This informative work is a reasonably detailed description of apparatus used in psychological laboratories. The author recommends, and I concur, that the maximum use of this book requires an acquaintance with elementary physics and the basic principles of electronics. This applies also as a preliminary to the course on which it is based, a course in psycho-physics and psycho-electronics laboratory techniques.

Behavior recording systems, timing and counting devices, instruments for auditory, visual, and other sensory measurements, learning and perceptual apparatus, and bioelectric-potentials recording mechanisms are the general classes of equipment treated. Calculating and computing devices and apparatus tests of individual differences in the capacity to perform certain tasks, such as manual manipulation and finger dexterity, are not described. The less sophisticated psychological laboratory technician will find the more common and not a few museum pieces among mirror drawing apparatus, stereoscope, mazes, color rotor, tuning fork, esthesiometer, Galton's whistle, phi-phenomena mechanism, Snellen chart, and the like, listed. The kymograph, sphygmomanometer, psychogalvanometer, electroencephalograph, and many other more complex instruments and devices are rather adequately explained.

The book is liberally illustrated with photographs and line drawings, most of them of good quality, but a few are somewhat crude, as for example the types of lenses (Fig. 5-3, p. 130). The value of the work is enhanced by the inclusion of manufacturers' addresses and adequate chapter references.

Although some attention is drawn to precautions in the use of electric stimulation systems, it seems to me that, inasmuch as the instruments described are relatively expensive, a note on proper care and servicing might have been included. Another precaution that might have been added relates to the interpretation of the records. Historical perspective might have become an added feature by the inclusion of dates for the various instruments and devices.

LESTER NICHOLAS RECKTENWALD

Department of Psychology, Villanova University

Books Reviewed in SCIENCE

3 June

- Manson's Tropical Diseases*, Philip Manson-Bahr, Ed. (Williams & Wilkins). Reviewed by T. T. Mackie.
The Nation Looks at Its Resources, Henry Jarrett, Ed. (Resources for the Future, Inc.). Reviewed by S. T. Dana.
Monomeric Acrylic Esters, Edward H. Riddle, (Reinhold). Reviewed by P. A. S. Smith.

10 June

- Millimicrosecond Pulse Techniques*, I. A. D. Lewis and F. H. Wells (McGraw-Hill). Reviewed by P. R. Bell.
Endemic Goiter, John B. Stanbury, Gordon Brownell, Douglas J. Riggs, Hector Perinetti, Juan Irdiz, and Enrique B. Del Castillo (Harvard Univ. Press). Reviewed by R. W. Rawson.
Transactions of the International Astronomical Union, vol. VIII, P. Th. Oosterhoff, Ed. (Cambridge Univ. Press). Reviewed by C. K. Seyfert.
Physical Methods of Organic Chemistry, vol. I, pt. III of *Technique of Organic Chemistry*, Arnold Weissberger, Ed. (Interscience). Reviewed by T. S. Gardner.
Decision Processes, R. M. Thrall, C. H. Coombs, and R. L. Davis, Eds. (Wiley; Chapman & Hall). Reviewed by I. Roshwalb.
Advances in Catalysis and Related Subjects, vol. VI, W. G. Frankenburg, V. I. Komarewsky, and E. K. Rideal, Eds. (Academic Press). Reviewed by H. H. Storch.

17 June

- Cellulose and Cellulose Derivatives*, pt. II, Emil Ott, Harold M. Spurlin, and Mildred W. Grafflin, Eds. vol. V of *High Polymers* (Interscience). Reviewed by G. A. Richter.
Treatise on Invertebrate Paleontology, Raymond C. Moore, Ed. pt. D, *Protista 3: Protozoa*, Arthur Shackleton Campell and Raymond C. Moore (Geological Society of America; Univ. of Kansas Press). Reviewed by E. W. Berry.
The Ocean Floor, Hans Pettersson (Yale Univ. Press). Reviewed by J. W. Hedgpeth.
Statistics in Research, Bernard Ostle (Iowa State College Press). Reviewed by F. J. Weiss.

- Advanced Organic Chemistry*, E. Earl Royals (Prentice-Hall). Reviewed by I. M. Hunsberger.
Dictionary of Mathematical Sciences, English-German, vol. II, Leo Herland (Ungar). Reviewed by A. S. Householder.
Mathematics in Type (William Byrd Press). Reviewed by M. F. Rosskopf.
Qualitative Analysis Using Semimicro Methods, Esmarch S. Gilreath (McGraw-Hill). Reviewed by W. MacNevin.
The Neuroanatomical Basis for Clinical Neurology, Talmadge L. Peele (McGraw-Hill). Reviewed by C. Van Buskirk.
Wool: Its Chemistry and Physics, Peter Alexander and Robert F. Hudson (Reinhold; Chapman & Hall). Reviewed by Wilfred H. Ward.
Sovereign Reason, Ernest Nagel (Free Press). Reviewed by A. Grünbaum.
The Vitamins: Chemistry, Physiology, Pathology, vol. III, W. H. Sebrell, Jr., and Robert S. Harris, Eds. (Academic Press). Reviewed by H. E. Sauberlich.

24 June

- Protozoology*, Richard R. Kudo (Thomas). Reviewed by W. Balamuth.
The Pineal Gland, Julian I. Kitay and Mark D. Altschule (Harvard Univ. Press). Reviewed by G. B. Wislocki.
K (*Krebiozen—Key to Cancer?)*, Herbert Bailey (Hermitage House). Reviewed by P. K. Smith.
Elements of Ecology, George L. Clarke (Wiley; Chapman & Hall). Reviewed by A. Carr.
Der Scharlach und seine Behandlung, W. Pulver (Huber). Reviewed by G. Rosen.
The Psychological Variables in Human Cancer, Joseph A. Gengerelli and Frank J. Kirkner, Eds. (Univ. of California Press). Reviewed by A. M. Sutherland.
Progress in the Chemistry of Organic Natural Products, vol. 11, L. Zechmeister, Ed. (Springer). Reviewed by W. Z. Hassid.
A Budget of Paradoxes, Augustus De Morgan (Dover). Reviewed by D. Roller.
Handbook of Textile Fibers, Milton Harris, Ed. (Harris Research Laboratories). Reviewed by F. J. Soday.

New Books

- Life Science.** A college textbook of general biology. Thomas S. Hall and Florence Moog. Wiley, New York; Chapman & Hall, London, 1955. 502 pp. \$6.50.
The Armenian Community. The historical development of a social and ideological conflict. Sarkis Atamian. Philosophical Library, New York, 1955. 479 pp. \$4.75.
Politics and Science. William Esslinger. Philosophical Library, New York, 1955. 167 pp. \$3.
Cytologie des Weiblichen Genitalkarzinoms. Edmund Schuller. Wilhelm Maudrich, Wien-Bonn, 1955. 129 pp. Paper, \$6.
Shell Theory of the Nucleus. Investigations in physics. Eugene Feenberg. Princeton Univ. Press, Princeton, N.J., 1955. 211 pp. Paper, \$4.

- Letalfaktoren in ihrer Bedeutung fur Erbpathologie und Genphysiologie der Entwicklung.** Ernst Hadorn. Thieme, Stuttgart, 1955. 338 pp. \$9.30.
Practical Horticulture. James S. Shoemaker and Benjamin J. E. Teskey. Wiley, New York; Chapman & Hall, London, 1955. 374 pp. \$4.20.
The Technique and Significance of Oestrogen Determinations. Memoirs of the Society for Endocrinology, No. 3. P. Eckstein and S. Zuckerman, Eds. Cambridge Univ. Press, New York, 1955. 96 pp. \$3.75.
Fundamental Formulas of Physics. Donald H. Menzel, Ed. Prentice-Hall, New York, 1955. 765 pp. \$10.65.
Plastics Tooling. Malcolm W. Riley. Reinhold, New York, 1955. 123 pp. \$2.50.

- Die Submikroskopische Struktur des Cytoplasmas.** Protoplasmatologia, vol. II, A2. A. Frey-Wyssling. Springer, Vienna, 1955. 244 pp. \$10.10 (Subscriber's, \$8.10).
- The Viking Rocket Story.** Milton W. Rosen. Harper, New York, 1955. 242 pp. \$3.75.
- The Continuum and Other Types of Serial Order.** With an introduction to Cantor's transfinite numbers. Edward V. Huntington. Dover, New York, ed. 2, 1955. 82 pp. Cloth, \$2.75; paper, \$1.
- Bird Recognition.** No. III. James Fisher. Penguin Books, Baltimore 11, 1955. 159 pp. \$0.85.
- Co-ordination of Galactic Research.** Symposium No. 1 of International Astronomical Union, 22-27 June 1953, at Groningen, Netherlands. A. Blaauw, Ed. Cambridge Univ. Press, New York, 1955. 58 pp. \$1.50.
- Almost Periodic Functions.** A. S. Besicovitch. Dover, New York, 1955 (Reissue of ed. 1, published by Cambridge Univ. Press). 180 pp. Cloth, \$3.50; paper, \$1.75.
- Dust Is Dangerous.** C. N. Davies. Faber & Faber, London; de Graff, New York, 1955. 116 pp. \$4.50.
- The Chemistry of Synthetic Dyes and Pigments.** H. A. Lubs, Ed. Reinhold, New York, 1955. 734 pp. \$18.50
- Canadian Cancer Conference.** vol. I. Proceedings of the first Canadian Cancer Research Conference, 16-19 June 1954 at Honey Harbour, Ontario. R. W. Begg, Ed. Academic Press, New York, 1955. 443 pp. \$8.80.
- Annual Review of Medicine.** vol. 6. David A. Ryland and John Anderson, Eds. Annual Reviews, Stanford, Calif., 1955. 459 pp. \$7.
- The Dynamical Theory of Gases.** J. H. Jeans. Dover, New York, ed. 4, 1955. 444 pp. Cloth, \$3.95; paper, \$2.
- Die Selbstgestaltung des Lebendigen.** Synoptische theorie des Lebens als ein Beitrag zu den philosophischen Grundlagen der Naturwissenschaft. Karl Friederichs. Reinhardt, Munchen-Basel, 1955. 221 pp. Cloth, F. 20.50; paper, F. 18.
- The Chemistry of Petroleum Hydrocarbons.** vols. II and III. Benjamin T. Brooks, Stewart S. Kurtz, Jr., Cecil E. Boord, and Louis Schmerling, Eds. Reinhold, New York, 1955. vol. II, 442 pp., \$13.50; vol. III, 690 pp., \$18.
- Advanced Part of a Treatise on the Dynamics of a System of Rigid Bodies.** Being part II of a treatise on the whole subject. Edward John Routh. Dover, New York, ed. 6, 1955. 484 pp. Cloth, \$3.95; paper, \$1.95.
- A Laboratory Manual for Introduction to Chemistry.** R. T. Sanderson and William E. Bennett. Wiley, New York; Chapman & Hall, London, 1955. 182 pp. \$3.
- The Facts of Life.** C. D. Darlington. Macmillan, New York, 1955. 467 pp. \$7.
- Psychische Hygiene.** Ernst Brezina and Erwin Stransky. Maudrich, Wien-Bonn, Germany, 1955. 282 pp. \$8.25.
- Physical Chemistry.** Farrington Daniels and Robert A. Alberty. Wiley, New York; Chapman & Hall, London, 1955. 671 pp. \$6.50.
- The Biology of the Amphibia** (unabridged republication of ed. 1). G. Kingsley Noble. Dover, New York, 1955. 577 pp. \$4.95.
- Optical Properties of Thin Solid Films.** O. S. Heavens. Academic Press, New York; Butterworths, London, 1955. 261 pp. \$6.80.
- A Manual of Medical Virology.** S. S. Kalter and J. E. Prier. Burgess, Minneapolis, 1955. 127 pp. \$3.50.
- Neutron Diffraction.** G. E. Bacon. Oxford Univ. Press, New York-London, 1955. 299 pp. \$5.60.
- Astronomy.** A textbook for university and college students. Robert H. Baker. Van Nostrand, New York-London, ed. 6, 1955. 528 pp. \$5.50.
- Organic Solvents: Physical Properties and Methods of Purification.** vol. VII, *Technique of Organic Chemistry*. Arnold Weissberger, Ed. Interscience, New York-London, ed. 2, 1955. 552 pp. \$8.50.
- Baba of Karo.** A woman of the Moslem Hausa. Mary Smith. Philosophical Library, New York, 1955. 299 pp. \$7.50.
- American Agriculture: Its Structure and Place in the Economy.** Ronald L. Mighell. Wiley, New York; Chapman & Hall, London, 1955. 187 pp. \$5.
- Target: Earth.** The role of large meteors in earth science. Allen O. Kelly and Frank Datchile. Target Earth, Box 335, Carlsbad, Calif., 1953. 263 pp. \$5.
- Bacterial Toxins.** W. E. Van Heyningen. Blackwell, Oxford, Eng.; Charles C. Thomas, Springfield, Ill., 1955. 133 pp. \$3.50.
- Methods of Quantitative Micro-Analysis** R. F. Milton and W. A. Waters, Eds. St Martin's Press, New York and Arnold, London, ed. 2, 1955. 742 pp. \$15.
- Quantitative Methods in Histology and Microscopic Histochemistry.** Olavi Eranko. Karger, Basel, Switzerland; Little, Brown, Boston, 1955. 160 pp. F. 19.75.
- Household Physics.** A textbook for college students in home economics. Madalyn Avery. Macmillan, New York, ed. 3, 1955. 472 pp. \$5.50.
- The Uranium Prospector's Guide.** Thomas J. Ballard and Quentin E. Conklin. Harper, New York, 1955. 251 pp. \$3.50.
- Aluminum Paint and Powder.** Junius David Edwards and Robert I. Wray. Reinhold, New York, ed. 3, 1955. 219 pp. \$4.50.
- Progress in Low Temperature Physics.** vol. I. C. J. Gorter, Ed. Interscience, New York; North-Holland, Amsterdam, 1955. 418 pp. \$8.75.
- Cycles and Performance Estimation.** Gas Turbine Ser. vol. I. James Hodge. Academic Press, New York; Butterworths, London, 1955. 329 pp. \$9.
- Schizophrener Prozess und Schizophrenie Symptomgesetze.** Eine Prognostisch-statistische grundlagenstudie. O. H. Arnold. Wilhelm Maudrich, Wien-Bonn, 1955. 86 pp. Paper, \$3.76.
- Frontier to Space.** Eric Burgess. Macmillan, New York, 1955. 174 pp. \$4.50.
- Ionography.** Electrophoresis in stabilized media. Hugh J. McDonald. Year Book, Chicago, 1955. 268 pp. \$6.50.
- Hatchery Operation and Management.** Ernest M. Funk and M. Richard Irwin. Wiley, New York; Chapman & Hall, London, 1955. 349 pp. \$6.50.
- Methods in Enzymology.** vol. I. Preparation and assay of of enzymes. Sidney P. Colowick and Nathan O. Kaplan, Eds. Academic Press, New York, 1955. 835 pp. \$18.
- Ovide moralise en prose.** Texte du quinzieme siecle. Edition critique avec introduction. C. De Boer. North-Holland, Amsterdam, 1954. 407 pp.
- Let's Have a Better World.** A program for progress and survival. Daniel Wolford La Rue. Exposition Press, New York, 1955. 240 pp. \$4.
- Catalogue of the Type Specimens of Microlepidoptera in the British Museum (Natural History) described by Edward Meyrick.** vol. I. J. F. Gates Clarke. British Museum Natural History, London, 1955. 332 pp. £3.
- Antibiotics Annual 1954-1955.** Proceedings of the 2nd annual symposium on antibiotics. Henry Welch and Felix Marti-Ibanez, Eds. Medical Encyclopedia, New York, 1955. 1154 pp.

ASSOCIATION AFFAIRS

Advantages of an Atlanta Meeting

The AAAS board of directors has received several communications urging that the 1955 meeting be moved from Atlanta, Georgia to a city in which segregation laws and customs do not prevail. The board considered these communications at its meeting on 11-12 June and concluded that the advantages of an Atlanta meeting needed clearer statement and wider dissemination than they had been given in 1953 when the decision to hold the 1955 meeting in Atlanta was reached.

In order to advance science and its public understanding, it is desirable that the American Association for the Advancement of Science hold meetings in every part of the country. Atlanta is a center of a region in which the Association has not met since 1913 and in which there has been impressive scientific, technologic, and educational growth.

Because the Association recognizes no distinction of color in the achievement of its purposes, the situation in Atlanta was carefully explored. It was determined that all program sessions, the exhibits, the Science Theater, and the Association's social functions—the Presidential Reception and the Biologists' Smoker—could all be held on a nonsegregated basis. Although all the professional activities are thus nonsegregated, it unfortunately remains true that segregation still obtains in hotels, restaurants, and transportation. The board believes, however, that scientists of all races will benefit from participation in this meeting, and that the advantages outweigh the disadvantages.

The board recognizes the existence of honest differences of opinion regarding the most effective means of reaching a common goal and made its decision to hold a meeting in Atlanta because it believes that the meeting will serve to "improve the effectiveness of science in the promotion of human welfare."

The anthropology section of the Association has decided not to hold any sessions at the Association's 1955 meeting in Atlanta because of the practices of racial segregation in that city. Several individuals and organizations have urged the whole Association not to meet in Atlanta. The decision to meet there was made in 1953 after a most careful study of all of the factors involved, and the board believes that the original reasons are valid.

BOARD OF DIRECTORS
AMERICAN ASSOCIATION FOR THE
ADVANCEMENT OF SCIENCE

Washington, D.C.,
12 June 1955

Hotel Headquarters and Housing, Atlanta Meeting

The preliminary announcement of the second Atlanta meeting 26-31 Dec., of the American Association for the Advancement of Science [*Science* 121, 751 (1955); *The Scientific Monthly* 80, 51 (1955)], although it named the Dinkler Plaza as AAAS headquarters hotel, was principally concerned with the programs of the 1955 meeting—as planned by 17 AAAS sections and some 38 participating societies and organizations. Approximately 25 additional societies and organizations will participate as official cosponsors of appropriate programs.

As in previous years, the focus of the Association's annual meeting will be a large convention hall, the Atlanta Municipal Auditorium. This well-designed building will be the site of the AAAS Registration-Information Center, the Visible Directory of Registrants, the AAAS Office, the Science Theatre, the Annual Exposition of Science and Industry, the Biologists' Smoker, and many of the principal sessions.

In the interest of a compact, unified meeting, most of the general events and the programs of the sections will be held at the auditorium or immediately across the street in the buildings of the Atlanta Division of the University of Georgia. The sessions of the participating societies, as far as possible, will be held in the downtown hotels, all of which are within a few blocks of the auditorium. The hotels of the Atlanta Biltmore-Georgia Tech area, 1½ miles to the north, are linked to the downtown hotels by the trackless trolleys that run along Peachtree Street; it is also planned to operate AAAS-chartered buses between the hotels and the auditorium, and to and from Atlanta University on the evening of the AAAS presidential address and reception there.

The technical or program sessions and the special sessions or evening lectures are open to all interested persons. Although registration for these is not mandatory, it is expected that all who attend will wish to pay the AAAS registration fee of \$2.50 (unchanged in recent years) and be a part of the meeting in all respects. Each registrant receives a Convention Badge, the book-size General Program-Directory, convention literature, and listing in the Visible Directory of Registrants. Also as usual, the exhibits, AAAS Science Theatre, and the Biologists' Smoker, and the presidential reception are open to all registrants.

A variety of dormitory units, rooms, and suites are available at Atlanta University; a limited num-

ber of dormitory units are available at the Georgia Institute of Technology, two men in a room at \$2.50 each per night. Applications for dormitory accommodations should be sent directly to the academic institution's Housing Office.

Because of existing local laws, separate hotel and motel accommodations are named for Negro members and visitors. These are the Royal Hotel and Savoy Hotel, both on Auburn Avenue a few blocks from the Municipal Auditorium, and the University Motel near Atlanta University.

Beginning with this issue, the advertising section of *The Scientific Monthly* will carry, at frequent intervals, page announcements of all housing facilities and their current rate schedules, together with a coupon which should be filled out and sent not to a hotel directly but to the AAAS Housing Bureau in Atlanta.

All applications will be filled in the order of their receipt. Those who apply early are assured of the hotel of their first choice if the stated desired and maximum rates are within the printed rate schedules. In Atlanta there is an adequate supply of rooms at a wide range of rates. It would be well to consider, however, that, as in any city, the supply of single rooms at minimum rates is relatively limited and higher-priced singles and double rooms for single occupancy are more plentiful. Thus, it is suggested that both *maximum rate* and preferred rate be stated on your coupon. Expenses can always be reduced if rooms or suites are shared by two or more friends.

Commonly, a person's preference may be the hotel named as the headquarters of his section or society, but, in each of the two zones, the hotels are conveniently close to one another. It is helpful to name at least a second choice of hotel. The headquarters of the 17 sections and participating societies follow (the societies are grouped in the same sequence as the letters of the sections).

Hotel Headquarters

Downtown Zone

Dinkler Plaza (600 rooms) 98 Forsyth St., NW: AAAS; Press; AAAS Sections F, I, Q; American Society of Parasitologists, Herpetologists League, Society of Systematic Zoology; American Society of Naturalists, Association of Southeastern Biologists, Ecological Society of America, National Association of Biology Teachers, Society of General Physiologists; Society for Research in Child Development; AAAS Cooperative Committee on the Teaching of Science and Mathematics, American Educational Research Association, Central Association of Science and Mathematics Teach-

ers, International Council for Exceptional Children, National Association for Research in Science Teaching, National Science Teachers Association; Academy Conference, American Nature Study Society, Conference on Scientific Editorial Problems, National Association of Science Writers, Scientific Research Society of America, Society of the Sigma Xi, United Chapters of Phi Beta Kappa

Henry Grady (550 rooms) 210 Peachtree St., NW: AAAS Sections C, N, Np; Alpha Chi Sigma, American Association of Clinical Chemists; American Chemical Society, Georgia Chapter; Alpha Epsilon Delta, American Academy of Forensic Sciences, American Association of Hospital Consultants, American Physiological Society, American Psychiatric Association; American Association of Colleges of Pharmacy, American College of Apothecaries, American Pharmaceutical Association, Scientific Section, and American Society of Hospital Pharmacists

Peachtree on Peachtree (200 rooms) 176 Peachtree St., NW: AAAS Section E; Association of American Geographers, Geological Society of America, National Geographic Society

Piedmont (450 rooms) 108 Peachtree St., NW: Georgia Minerals Society; National Speleological Society

Georgia (300 rooms) 114 Luckie St., NW: AAAS Section Nd; American College of Dentists, American Dental Association, International Association for Dental Research, American Division

Atlantan (300 rooms) 111 Luckie St., NW

Hampton (125 rooms) 35 Houston St., NE

Imperial (150 rooms) 355 Peachtree St., NE

Jefferson (125 rooms) 87 Pryor St., SW

Hotels for Negroes

Royal, 214 Auburn Ave., NE

Savoy, 239 Auburn Ave., NE

University Motel, 55 Northside Drive, NW

Georgia Tech Zone

Atlanta Biltmore (600 rooms) 817 W. Peachtree St., NE: AAAS Sections A, B, D, G, M, O; American Meteorological Society, Oak Ridge Institute of Nuclear Studies, Sigma Pi Sigma; American Phytopathological Society, APS, Southern Division, American Society of Plant Physiologists, Southern Section, Botanical Society of America, Southeastern Section; Conference on Scientific Manpower, Engineering Manpower Commission, Scientific Manpower Commission; visiting members, Association of

Southern Agricultural Workers; American Geophysical Union, International Geophysical Year
Georgian Terrace (300 rooms) 659 Peachtree St., NE: AAAS Sections K, L, P; National Academy of Economics and Political Science, Society for the Advancement of Criminology; Philosophy of Science Association, Society for the Advancement of General Systems Theory, Southern Society for Philosophy and Psychology
Cox-Carlton (150 rooms) 683 Peachtree St., NE
Peachtree Manor (125 rooms) 826 Peachtree St., NE

Advance Registration and Advance Copies of General Program-Directory

As in past years, those who plan to attend the meeting may register in advance and receive both a Convention Badge and a copy of the General Program-Directory, by first class mail, early in December. The registration fee of \$2.50 includes postage. Those who cannot attend the meeting but would like an advance copy of the General Program-Directory may also obtain it by first class mail early in December at cost—\$1.50. A coupon covering both alternatives will be found on another page in the advertising portion of this issue. The appropriate square should be checked.

Sectional Sessions for Contributed Papers

Ten sections of the Association will arrange sessions for contributed papers at the Atlanta meeting. The secretaries to whom titles and brief abstracts should be sent, *not later than 30 Sept. 1955*, follow.

- C—Chemistry.** Dr. Ed. F. Degering, 26 Robinhood Road, Natick, Mass.
- D—Astronomy.** Dr. Frank K. Edmondson, Goethe Link Observatory, Indiana University, Bloomington, Ind.
- E—Geology and Geography.** Dr. Robert L. Nichols, Department of Geology, Tufts College, Medford, Mass.
- F—Zoological Sciences** (if outside the scope of the American Society of Parasitologists and the Society of Systematic Zoology, which are meeting with the AAAS). Dr. Harold H. Plough, Department of Biology, Amherst College, Amherst, Mass.
- G—Botanical Sciences** (if outside the scope of the American Phytopathological Society, which is meeting with the AAAS). Dr. Barry Commoner, Henry Shaw School of Botany, Washington University, St. Louis, Mo.
- I—Psychology.** Dr. William D. Neff, Department

of Psychology, University of Chicago, Chicago, Ill.

L—History and Philosophy of Science. Dr. Jane M. Oppenheimer, Department of Biology, Bryn Mawr College, Bryn Mawr, Pa.

Nd—Dentistry. Dr. Russell W. Bunting, School of Dentistry, University of Michigan, Ann Arbor

Np—Pharmacy. Dr. John E. Christian, School of Pharmacy, Purdue University, Lafayette, Ind.

Q—Education. Dr. Dean A. Worcester, University of Nebraska, Lincoln

RAYMOND L. TAYLOR
Associate Administrative Secretary, AAAS

AAAS Committees and Representatives for 1955

(Numerals in parentheses indicate year of expiration of term)

Standing Committees

AFFILIATION AND ASSOCIATION

(1955) L. V. Domm, chairman, Loyola University, Chicago

(1956) Fernandus Payne, Indiana University

(1957) I. Melville Stein, Leeds & Northrup Company, Philadelphia

(1958) Howard A. Meyerhoff, Scientific Manpower Commission

(1959) Herbert Carter, University of Illinois
 Dael Wolfe, *ex officio*

AAAS MEETINGS

Leonard Carmichael, Smithsonian Institution
 Bernard D. Davis, New York University College of Medicine

John E. Ivey, Jr., Southern Regional Education Board, Atlanta

Harry C. Kelly, National Science Foundation

Howard M. Phillips, Emory University

Raymond L. Taylor, *ex officio*

Dael Wolfe, *ex officio*

EXECUTIVE

Warren Weaver, *chairman*, Rockefeller Foundation; retiring president and chairman of the board of directors, AAAS

George W. Beadle, California Institute of Technology; president, AAAS

Paul B. Sears, Yale University; president-elect, AAAS

Wallace R. Brode, National Bureau of Standards

Paul E. Klopsteg, National Science Foundation

Dael Wolfe, AAAS

INVESTMENT AND FINANCE

(1955) L. Clark Brown, Rohrbaugh and Company, Washington, D.C.

(1956) Sheldon B. Akers, *vice chairman*, The Brookings Institution

(1957) F. P. H. Siddons, *chairman*, American Security & Trust Company, Washington, D.C.

(1958) Malvern F. Morse, American Security & Trust Company, Washington, D.C.

(1959) Wallace R. Brode, National Bureau of Standards

Paul A. Scherer, *ex officio*

Dael Wolfle, *ex officio*

PUBLICATIONS

(1955) E. U. Condon, consulting physicist, Berkeley, California

(1956) Paul B. Sears, *chairman*, Yale University

(1957) Thomas Park, University of Chicago

(1958) Ralph R. Shaw, Rutgers University

(1959) Chauncey D. Leake, University of Texas, Medical Branch

Dael Wolfle, *ex officio*

Special Committees

AAAS-ANNE FRANKEL ROSENTHAL MEMORIAL AWARD FOR CANCER RESEARCH

Warren Weaver, *chairman*, Rockefeller Foundation; retiring president and chairman of the board of directors, AAAS

Jacob Furth, American Association for Cancer Research

G. Burroughs Mider, National Cancer Institute

Richard L. Rosenthal, Richard and Hinda Rosenthal Foundation

C. Chester Stock, Sloan-Kettering Institute for Cancer Research

Harry M. Weaver, American Cancer Society

CONSTITUTION, BYLAWS, AND

GENERAL OPERATIONS

Wallace R. Brode, *chairman*, National Bureau of Standards

Roger Adams, University of Illinois

Meredith F. Burrill, U.S. Geological Survey

Clarence E. Davies, American Society of Mechanical Engineers

Milton O. Lee, Federation of Society for Experimental Biology

Howard A. Meyerhoff, *adviser*, Scientific Manpower Commission

Dael Wolfle, *adviser*, AAAS

MANAGEMENT AND BUSINESS OPERATIONS

Mark Ingraham, *chairman*, University of Wisconsin

George J. Beal, Rockefeller Foundation (retired)

F. P. H. Siddons, American Security & Trust Company, Washington, D.C.

Paul A. Scherer, *ex officio*

Dael Wolfle, *ex officio*

MEMBERSHIP DEVELOPMENT

Ralph Gerard, *chairman*, University of Illinois, Chicago

Clarence E. Davis, American Society of Mechanical Engineers

Rensis Lickert, University of Michigan

Dael Wolfle and all members of the AAAS staff as consultants

RESEARCH GRANTS, AAAS

Barry Commoner, *chairman*, Washington University

E. Lowell Kelly, University of Michigan

Hans Nussbaum, AAAS

Laurence H. Snyder, University of Oklahoma

H. Burr Steinbach, University of Minnesota

Dael Wolfle, *ex officio*

RETIREMENT PLAN (must be three staff members)

Dael Wolfle, *chairman*, AAAS

Hans Nussbaum

Raymond L. Taylor

SOCIO-PSYCHOLOGICAL PRIZE JUDGING COMMITTEE

Leon Festinger, University of Minnesota

Theodore M. Newcomb, University of Michigan

Fred L. Strodbeck, University of Chicago

SOURCE BOOKS IN THE HISTORY OF SCIENCE

Gregory D. Walcott, *chairman*, Long Island University

Harlow Shapley, Harvard University

Edmund W. Sinnott, Yale University

Dael Wolfle, *ex officio*

THEOBALD SMITH AWARD JUDGING COMMITTEE

S. E. Luria, University of Illinois, chairman of Section N, *ex officio*, *chairman*

Allan D. Bass, Vanderbilt University, secretary of Section N, *ex officio*, *secretary*

R. J. Dubos, Harvard Medical School; Rockefeller Institute for Medical Research

Chester S. Keefer, Robert Dawson Evans Memorial Hospital, Boston, Massachusetts

Karl Mason, University of Rochester School of Medicine and Dentistry

Severo Ochoa, New York University College of Medicine

Committees to be Appointed

NEWCOMB CLEVELAND PRIZE

RESOLUTIONS

Representatives

REPRESENTATIVES ON AMERICAN COUNCIL ON EDUCATION

Mark Ingraham, University of Wisconsin

Laurence H. Snyder, University of Oklahoma

REPRESENTATIVE OF BOARD OF DIRECTORS ON COOPERATIVE COMMITTEE ON THE TEACHING OF SCIENCE AND MATHEMATICS

Harold Schilling, Pennsylvania State University

REPRESENTATIVES ON BOARD OF TRUSTEES OF SCIENCE SERVICE

(1956) Kirtley Mather, Harvard University

(1957) Paul B. Sears, Yale University

(1958) Karl Lark-Horovitz, Purdue University

REPRESENTATIVE ON COUNCIL OF NATIONAL ORGANIZATIONS OF THE ADULT EDUCATION ASSOCIATION OF THE UNITED STATES

John A. Behnke, AAAS

REPRESENTATIVE ON COUNCIL OF OLD WORLD ARCHAEOLOGY

Richard K. Beardsley, University of Michigan

REPRESENTATIVE ON COMMITTEE OF THE KIMBER GENETICS AWARD OF THE NATIONAL ACADEMY OF SCIENCES

I. Michael Lerner, University of California, Berkeley

REPRESENTATIVE ON NATIONAL CITIZENS COMMITTEE FOR EDUCATIONAL TELEVISION ADVISORY COMMITTEE

John A. Behnke, AAAS

REPRESENTATIVE ON NATIONAL COMMITTEE FOR UNESCO

Elvin C. Stakman, University of Minnesota, St. Paul

REPRESENTATIVE ON NATIONAL CONFERENCE ON FAO

Noble Clark, University of Wisconsin, Agricultural Experiment Station

REPRESENTATIVES ON SCIENTIFIC MANPOWER COMMISSION

Detlev W. Bronk, Rockefeller Institute for Medical Research

Dael Wolfe, AAAS

REPRESENTATIVES ON U.S. COMMITTEE ON ISO TECHNICAL COMMITTEE 37—TERMINOLOGY

Duane Roller, Ramo-Wooldrige Corporation, Los Angeles

REPRESENTATIVES ON WORLD FEDERATION OF ASSOCIATIONS FOR THE ADVANCEMENT OF SCIENCE

Kirtley Mather, *chairman*, Harvard University

Detlev W. Bronk, Rockefeller Institute for Medical Research

Karl Lark-Horovitz, Purdue University

Dael Wolfe, *ex officio*

Theobald Smith Award in the Medical Sciences

The Theobald Smith award of \$1000 and a bronze medal, which has been given yearly since 1937 (except for a lapse during the war years) by Eli Lilly and Company of Indianapolis, under the auspices of the American Association for the Advancement of Science, will be given at the Association's 122nd meeting to be held in Atlanta, Georgia, 26-31 December 1955.

Nominations are now being requested for the award. They may be made by fellows of the AAAS and should be sent to the secretary of the Section on Medical Sciences, Allan D. Bass, M.D., Department of Pharmacology, Vanderbilt University School of Medicine, Nashville 5, Tennessee. Nominations should be accompanied by full information concerning the nominee's personality, training, and research work.

The prize is given for "demonstrated research in the field of the medical sciences, taking into consideration independence of thought and originality." Any investigator who was less than 35 years old on 1 January 1955 and is a citizen of the United States is eligible. The research is not to be judged in comparison with the work of more mature and experienced investigators.

Nominations must be received before 1 September 1955. The secretary requests that *six copies* of all data be submitted. The vice president of Section N of the Association and four fellows will form the committee of award. Past recipients are Robley D. Evans, MIT (1937); Charles F. Code, Mayo Foundation (1938); Albert B. Sabin, Children's Hospital Research Foundation, Cincinnati (1939); Herald R. Cox, Lederle Laboratories (1941); Sidney C. Madden, Brookhaven National Laboratory (1943); Seymour S. Kety, Graduate School of Medicine, University of Pennsylvania (1949); C. Walton Lillehei, University of Minnesota Medical School (1951); Frank W. Dixon, Jr., University of Pittsburgh School of Medicine (1952); Irving M. London, College of Physicians and Surgeons (1953); and Winston H. Price, Johns Hopkins School of Hygiene and Public Health (1954).

